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DISEASES OF DAIRY COWS.

(Continued.)

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IV. TEMPORARY STERILITY.

THE condition or disorder known as "temporary sterility" or "returning to the bull" presents a most perplexing problem of the greatest economic importance in New Zealand and elsewhere in the world where dairy-farming is practised. As the name suggests, conception occurs sooner or later, and the cow carries her calf to the end of the normal gestation. The cow comes in season regularly, and only after repeated services at recurring "heat" periods does she become pregnant. There are presumably no definite clinical symptoms, no pathological changes—in fact, nothing to indicate the seat of the trouble or the reason for this breeding anomaly.

It is particularly in New Zealand that temporary sterility has led to such heavy losses. The reason for this is not far to seek when one recognizes the need for seasonal calvings in order to catch the early spring growth, and at the same time to utilize to full advantage the succulent early summer pastures before the onset of the dry spell which so frequently sets in by midsummer. With delayed conception, pregnancy occurs too late in the season, with the result that the cow comes into profit at the wrong time of the year—winter dairying not being the practice in this country.

It must be appreciated that temporary sterility occurs in most dairying countries, but whether or not the inciting causes or predisposing factors are the same it is difficult to say. The importance to be attached to this type of sterility is governed by the methods of dairying in vogue, whether one-season calvings or spring and autumn calvings are necessary for the purposes of the trade, or whether calvings can be permitted at any season of the year. Seasonal calvings are the rule in New Zealand, and accordingly a temporary failure to conceive presents a problem of ever-increasing importance, far greater even than the losses occasioned by genital defects and inflammations which permanently prevent conception.

Again, in countries where the cows are housed for almost six months of the year, and artificial feeding has to be resorted to, many other factors are at work which favour the incidence of breeding anomalies of a sterilizing nature. These, however, invariably lead to "permanent" sterility. If, perchance, a "temporary" sterility is occasioned by a deficiency in the pasture, soil, or drinking-water, then it can easily be appreciated that such temporary sterility is likely to be more common in countries where the cows are given no concentrates whatever than in those where artificial feeding must be resorted to when the cows are housed during the winter, and where a reduced ration of concentrates is fed even during the summer months when the cows are at pasture. This is assuming, of course, that a rational system of feeding is being adopted under such conditions.

Another aspect of the problem presents itself, and that concerns the bull in those areas where seasonal calvings are desirable. The object aimed at is a breeding efficiency of close on 100 per cent., and that spread over at the most two months of the year. It is hoped under such circumstances to get all cows in calf at the first or at most the second service, whether the bull is running with the cows or service by hand is practised. It is feasible, therefore, to assume that under this method of breeding it is impossible to get anything like 100 per cent. breeding efficiency, for it is a well-established fact that too many services by the bull during a comparatively short period will result in too many "returns," and even more so than putting too many cows to the same bull over a relatively long period.

Incidence of Temporary Sterility.

The geographical distribution of this condition in New Zealand naturally follows those districts where dairy-farming is most intensively practised, and consequently one would expect the losses to be most severe in Taranaki and the Waikato, but other districts are far from immune. The local incidence would appear to vary considerably: one farm may experience an unexpected occurrence this year, and next year, apart from the late calvings, no cases of this disorder will be reported. Temporary sterility—which may be assumed to include all cases where conception has not occurred after the second service—may account for close on 100 per cent. failures on one farm, while on the adjoining farm, where conditions of management are presumed to be the same, the condition is unknown.

All breeds kept under the dairying conditions and management met with in New Zealand are equally susceptible. The age incidence is presumed to have very little bearing on temporary sterility, but occasionally the trouble would appear to commence and prevail among the heifers.

The seasonal occurrence naturally centres round the breeding-season—from about November to March. It is remarkable to find that by the month of January probably close on 95 per cent. of the herd have become pregnant, and the remaining 5 per cent. are either disposed of, or are kept through the winter as strippers, when they usually hold to the first service. From year to year the incidence of temporary sterility would appear to be most

erratic, and in the absence of reliable data to the contrary this condition is presumed to have become decidedly worse during the past ten years. In the present state of our knowledge of its occurrence it may be assumed that outbreaks may occur on all types of pasture. Within the herd any percentage or even all of the cows may appear to be affected to a greater or less extent.

Data concerning Temporary Sterility.

Valuable work on the disorder in New Zealand has already been done, and much useful information is now being collected by the veterinary officers of the Department of Agriculture. The greatest difficulty in the investigational work in connection with this form of sterility is to be found in the fact that the majority of farmers allow the bull to run with the herd, with the result that breeding data are not available, excepting only the information that several of the cows were "empty" at the end of the season. Therefore it is only in herds where the bull is kept apart from the herd, and each cow is brought for service as occasion arises, that reliable figures are available. The herd which is maintained entirely by home-reared heifers and young bulls which have not previously been used permits of a statistical survey and analysis over a period of years.

The number of abortions and the extent of infection with *Bacillus abortus* (the causal organism of contagious bovine abortion) must also be considered in connection with temporary sterility.

More recently the question of overproduction or unduly continued production as a possible cause of temporary sterility in dairy cows has been receiving considerable attention, and it is expected that from the reliable and authentic data now available from the herd-testing organizations very useful information will be obtained which may throw considerable light on this perplexing problem.

A considerable number of soil and pasture analyses have been undertaken, but many more will have to be made available before a definite pronouncement can be made regarding the condition. This would apply also to the biochemical aspect of the problem.

Finally, and perhaps most important of all, the study of the œstrous cycle in both normal and sterile cows, under field and herd conditions, will have to be undertaken in a systematic manner, to be followed up later at the meat-works when the opportunity presents itself.

From what has just been stated it is evident that the position regarding temporary sterility is very unsatisfactory, and before anything tangible can be arrived at sufficient data must be amassed to meet the requirements outlined above.

Œstrum, Conception, and Pregnancy.

Before proceeding to outline the various causes presumed to lead to temporary sterility it will be of value to understand the natural sequence of events necessary for a successful mating to result in conception, and for the female to continue in pregnancy until the normal parturition. The ovary must be considered the altogether

dominating portion of the genital complex, since its function is closely associated with the appearance and disappearance of certain different tissue formations within its substance. Here are to be found the follicles, the corpora lutea, and interstitial tissue, whose functional activities are constantly associated with definite cyclical changes associated with œstrum, ovulation, conception, and pregnancy. Pregnancy results more or less in an interruption of these cyclical changes, but after parturition or calving the œstrous cycle is again renewed.

The follicles develop rapidly just prior to the manifestation of œstrum or heat, and each follicle contains an ovum, which is liberated by the rupture of the follicle at the opportune moment for fertilization, or otherwise should service not be permitted. It will be evident, therefore, that the temporal relationship between ovulation—*i.e.*, rupture of the follicle and liberation of the ovum—and the appearance of œstrum or heat is all-important. Authorities differ as regards the exact moment of ovulation, but Nielsen considers that most probably ovulation occurs immediately before or during the first stage of heat, although the time of ovulation relative to œstrum may, and certainly does, vary considerably.

The scar or wound resulting from the rupture of the follicle heals over and forms the corpus luteum or "yellow body" of œstrum or pregnancy, as the case may be. The presence of the corpus luteum is definite proof that ovulation has taken place at a shorter or longer time previously, depending upon the age of the corpus luteum. The corpus luteum gradually increases in size till the eleventh day after œstrum, when it is at its maximum, and then gradually contracts, thus constituting the corpus of œstrum. After conception—that is, when the liberated ovum is fertilized—the resulting corpus luteum of pregnancy persists throughout pregnancy, gradually increasing in size during the earlier months and regressing after the middle of pregnancy.

The interstitial tissue of the ovary results from the degeneration of the immature follicles, since many are formed just preceding heat, but only one is ruptured at each œstrum with the liberation of one ovum. This degeneration of the follicles is governed by the actively secreting corpus luteum.

The function of the various tissue formations is bound up in the mechanism culminating in œstrum, conception, and pregnancy, and accordingly a clear understanding of these functions is essential in the study of temporary sterility.

The lutein body, acting as a ductless gland, or endocrine organ, is now presumed to function as follows: (1) To govern the formation of the interstitial tissue; (2) to prevent further ovulation, by inhibiting the growth of the follicles; (3) to determine the development of the placenta or after-birth and the growth of the uterus or womb; (4) to secure the connection between the maternal and fœtal placentæ, and to nourish the fertilized ovum or fœtus.

The functions of the interstitial tissue may be summarized as: (1) To govern the normal indications of œstrum; (2) to favour the development of the mammary gland, the secondary sexual characters, and the genital tract; (3) to influence the general metabolism and temperament.

Finally, the functions of the follicles may be concerned with the following: (1) The normal occurrence of œstrum; (2) the maturation and liberation of the ovum, which implies the act of ovulation.

The normal occurrence of œstrum is regulated by the activities of presumably both the interstitial tissue and the follicles, which are in turn governed by the corpus luteum, the former producing a secretion inducing œstrum, and the latter a secretion inhibiting it, but favouring attachment and development of the embryo, at least during the earlier stages of pregnancy.

To conclude, the fertilization of the ovum after service takes place either within the tubes leading from the ovary, or within the uterus or womb, where in either case it becomes implanted, obtains its nourishment, and rapidly grows to form the fœtus or calf. After conception the cervix or opening into the womb from the vagina becomes sealed, and remains so until parturition.

It can be easily understood that the physiological processes concerned with reproduction of the species presents, even under normal conditions, an ever-changing complex, so much so that under certain circumstances a temporary derangement of these processes is not to be wondered at. Exactly what takes place is exceedingly difficult to say, but, excluding infection or other pathological conditions, it can be seen that there are at least three possibilities: (1) The occurrence of œstrum and the act of ovulation are not coincident, the latter taking place too soon or even too late, thus making fertilization impossible, at least temporarily; (2) ovulation does not take place, although œstrum is apparently normal and service satisfactory; (3) the temporal relationship between the occurrence of ovulation and the manifestation of œstrum is normal, and conception occurs, but death of the embryo takes place at a very early stage, from implantation being impossible.

This interpretation of the functional derangement associated with temporary sterility would appear to explain what actually takes place in those cases where the cow comes in season at regular physiological intervals and no pathological changes can be demonstrated even at post-mortem examination. Such animals may miss several services before conception occurs, and in many cases seem to conceive after a prolonged rest.

Causes of Temporary Sterility.

The predisposing or contributory causes leading to temporary sterility in dairy stock would of necessity be many and varied, and at the present state of our knowledge many theories have been elaborated to explain this breeding anomaly. At the outset, therefore, it must be understood that in the absence of reliable data concerning the condition in New Zealand, and in view of the incomplete nature of the experimental work at present in progress, the writer wishes to submit only a short summary of the main lines of thought at present held. Many of the statements here made may still be controversial, but space does not permit of detailed criticism being given. In arriving at many of the conclusions herein recorded the writer has behind him many years of practical experience among

dairy stock in both health and disease, and also the recent views of many European workers in the field of sterility among bovines.

For purposes of classification it may be assumed that the causes of temporary sterility can be summarized under three main heads: (1) Infection or pathological conditions; (2) deficiencies in the pasture or diet; (3) physiological derangement, resulting from either of the foregoing or from irrational management.

(1) INFECTION.

The facts submitted from many farms would appear to justify the view that infection of some sort is wholly responsible for temporary sterility. However, extensive bacteriological examination of material collected from all situations in the genital tract of both the female and the male have been carried out in all parts of the world, and no particular organism has been isolated which could reproduce the condition.

The view that *B. abortus* may be responsible for many cases of temporary sterility has been tenaciously held for many years. This, however, presumes the existence of an endometritis or inflammation of the womb—at least during the few weeks after the act of abortion or even normal calving when the organism can be isolated from the uterine discharges. Usually in about three weeks time the uterus has freed itself of all infection, and only on one occasion have the bacilli been demonstrated after fifty-one days. In herds where contagious abortion is in evidence the first œstrum at least should be missed, and preferably the second also, thus allowing possibly over sixty days for the migration of the organisms from the uterus, and the disappearance of the endometritis. Information to hand from our field investigations would suggest that at least in New Zealand infection with *B. abortus* can be ruled out as a possible cause of temporary sterility.

Pathological changes or inflammations, possibly bacterial, have been met with in many cases of sterility, and as occasion arises each and every one of these conditions as hypotheses have had their supporters. Accordingly a short survey is given.

Endometritis.—Inflammation of the uterus has been dealt with in the preceding article of the series as a cause of sterility. It will therefore suffice to state that, at least in New Zealand, the post-mortem findings in cows culled as suffering from temporary sterility did not reveal an endometritis. Stalfors also reports that he examined the uterine contents of forty-four cows showing incomplete involution by means of washings with sterile water, and in all cases no pathogenic bacterial flora could be demonstrated. Again, Nielsen states that in cows suffering from endometritis heat manifestations after the third month are frequently very irregular, this irregularity increasing with the degree of chronic endometritis present, and in some cases there is even complete absence of heat. Such is not the case under New Zealand conditions where temporary sterility is common.

Salpingitis.—Inflammation of the tubes leading from the ovaries into the uterus is often met with in bovines, and the significance of salpingitis in sterility has been urged, by Williams in America and Oppermann in Germany, on the basis of infection within the tubes.

Hundsberger would appear to negative such an assumption, since in his extensive examinations he found bacteria more often in the tubes of pregnant than of non-pregnant animals.

Sterilizing Anomalies of the Ovaries.—Here the problem is intimately linked up with the ovarian cyclical changes already described, and in addition inflammations, persistent lutein bodies, cystic degenerations, &c., but, except in a very few cases, clinical examinations per rectum and per vagina, and post-mortem examinations fail to lend support to pathological changes in the ovaries causing temporary sterility. Congenital and acquired hormonal defects causing a temporary derangement may offer a suitable explanation, which will be discussed later.

Cervicitis.—Recently in New Zealand great prominence was given cervicitis, or inflammation of the canal leading from the vagina to the uterus, as at least a cause of the condition, but experimental data now available have not established this fact.

Vaginitis.—Opinions differ regarding the bearing of both granular and vesicular vaginitis on sterility in a herd, but at the present time in Europe infectious vaginal catarrh, which for many years was regarded in Germany, Austria, and Switzerland as the main cause of sterility, is considered as a fairly innocent complaint which has little to do with infertility, except in heifers, where it appears not infrequently with particularly acute symptoms, and thus service is resented and conception impossible. Yet heifers and cows suffering from vaginitis in its worst form have become pregnant.

(2) DEFICIENCIES IN THE PASTURE OR DIET.

This part of the investigation opens up a very large field with many ramifications, since it is understood that deficiencies in the natural grazing or in the diet otherwise provided will of necessity be reflected on the animal. Accordingly in order to facilitate the discussion the problem has been considered under two heads, one dealing with the soils, the pastures, and the diet, and the other with the animal itself, although more correctly they cannot be so divided. In most dairying countries analyses of the soils, the pastures, and the drinking-water have been carried out, and deficiencies of various kinds have been found, but interest seems to centre round calcium, phosphorus, and iodine, and more recently vitamin E, the anti-sterility accessory food factor.

Calcium.—Calcium of itself, when deficient in the pasture, where it may be reduced to less than one-fifth of that found in good grazings, is not seriously considered as a factor in temporary sterility. In support of this, liming experiments have not resulted in any great diminution in the incidence of the condition, other factors being considered.

Phosphorus.—Poverty of phosphorus may be even more marked than in the case of calcium, and definite evidence is now available to show that sterility may occur from a deficiency of it. "Waihi disease" in New Zealand occurs on soils deficient in phosphorus, as low as 0·20 per cent. of P_2O_5. Oestrum does not occur and the lutein bodies are retained, and thus a permanent sterility results. Similar

conditions are to be found in other parts of the world. Preliminary investigations in this country indicate a normal calcium content in connection with temporary sterility, but invariably in areas where the condition is prevalent the phosphorus content is low, though usually not sufficiently to cause a definite pathological change.

Iodine.—When considering the question of disease in New Zealand one thinks of a deficiency of iodine, and in regard to temporary sterility in dairy cows the lack of iodine would certainly appear to be a factor worth investigating. The success claimed for the iodine treatment of sterility in Europe would appear to justify such a claim, and accordingly if a deficiency of iodine in either the pasture or the drinking-water does exist it is only of a seasonal nature. In support of this hypothesis it is interesting to understand the effect of iodine on the genital tract, or, in other words, the animal's requirements in respect of same.

The iodine found in the thyroid glands of milch-cows shows a seasonal variation, being low in spring and high in autumn. This would probably indicate a correlation with the iodine content of the pasture, since the amount of iodine present in the thyroids is directly governed by the iodine intake. Milk, again, shows a seasonal variation in iodine content, being high in spring and low in autumn. Colostrum shows a higher iodine content, which quickly drops to milk-level in the course of a few days. The amount of iodine in the blood of the female is apparently affected by the sexual cycle, being high during œstrum and again at the end of pregnancy. The iodine content of the ovary as a whole is not high relative to other tissues and organs of the body, but very small lutein bodies have a relatively high percentage of iodine, whereas the very large ones appear to have a low iodine content.

The exact bearing or influence which the thyroid has on the sex organs has yet to be determined, but it will suffice to state that thyroid feeding inhibits the development of the uterus, the implantation of the ovum, and also the nutrition of the fœtus. Since, however, the processes of implantation of the ovum and the development of the uterus depend upon the normal functioning of the lutein body, it is evident that thyroid feeding or hypertrophy of the thyroid interferes with the formation or normal functioning of the lutein body.

With these facts in view the position may be summarized as follows: There is a low iodine intake in the early spring, a low iodine content of the thyroid, a resulting hypertrophy of same, a further rapid depletion of the system in connection with parturition, owing to the increased iodine content of the blood at this stage, which is eliminated in the colostrum.

This hypothesis does not necessarily suggest a definite deficiency of iodine in the soil, but a deficiency in the pasture just prior to and coincident with the early spring growth. The question of the water-supply may have a bearing on this also, and from preliminary analyses to hand of the soil in areas where sterility is common the iodine content is relatively high, although the iodine content of the drinking-water is exceedingly low, amounting to a definite deficiency for purposes of normal metabolism in bovines.

Again, the success attending the use of dilute iodine solutions in treating cases of sterility which are definitely not due to endometritis is difficult to explain. Formerly it was considered that this success resulted from a disinfection of the uterus, but it is now presumed that it is more of a stimulation. To go a step further, it is feasible that the iodine is absorbed, reaches the thyroid and ovaries, and brings about a return to normality of the physiological processes associated with reproduction.

Further work is still to be done, and as yet it is impossible to give a definite pronouncement on the supposed temporary iodine deficiency as an important factor in temporary sterility.

Vitamin E.—Evans and Burr, of California, have carried out a considerable amount of experimental work in connection with this recently discovered anti-sterility vitamin, but unfortunately their published data deals only with experiments on rats.

In the presence of a deficiency of vitamin E normal conception appears to take place, and growth of the embryo proceeds till about the eighth day; death of the fœtus occurs from interrupted nutrition about the fourteenth day—that is, towards the middle of the gestation period.

It has not yet been decided how a deficiency of this vitamin affects pregnancy in bovines, but if conception actually occurs in cases of temporary sterility then death of the embryo must take place, probably within the first week following conception. The recurrence of œstrum at regular three-weekly intervals would appear to negative this.

Vitamin E is found in greater or less extent in natural pastures and in milk, and although a systemic depletion may result during lactation it is hardly feasible to suggest a complete depletion with resulting ill effects. Again, the possibility of vitamin E being present in excess during the flush of grass may have a bearing on temporary sterility, but until experimental evidence with laboratory animals is forthcoming this hypothesis may be disregarded.

(To be continued.)

Classification of Pigs.—The pigs in New Zealand at the 1928–29 enumeration (including boroughs) are classified as follows, the figures for the preceding year being added in parentheses: Pigs one year old and under, 466,773 (488,292); boars one year old and over, 15,267 (15,503); sows one year old and over, 74,692 (83,103): total, 556,732 (586,898), representing a decrease of 5·14 per cent. for 1928–29.

Orchard Spray Piping Systems.—Reporting on recent experiences, Mr. J. H. Thorp, Orchard Instructor, Nelson, states: An instance of the blocking of pipes underground came under notice during last spring, resulting in the fruit-grower having to take up a few hundred feet of ½ in. piping, which he replaced with ¾ in. This grower uses a lot of Bordeaux powder and precipitated sulphur through his pipes, and no doubt this accounted for the trouble, as the pipes were clogged with a slimy, mucky mixture which interfered with the pressure. In several instances growers who have put in ¾ in. pipes have had to replace with ½ in. on account of the low pressure obtainable from the ⅜ in. pipe.

GRASSLAND EVOLUTION AT TUTIRA.

TURFS OF FIFTY YEARS.

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TWENTY-ONE years ago a paper on the grasses of Tutira appeared in the "Transactions of the New Zealand Institute." That article having now attained its majority, it may be worth while reconsidering the tendencies therein described. Even at that time these tendencies, it need hardly be told, were towards deterioration: the conclusion reached in the paper of 1908 was that the countryside was intrinsically worth less for grazing purposes than it had been in 1879, when grasses were first sown; and, secondly, that its higher assessment was owing to a greater demand for land, and in a lesser degree because of better methods of farming and increased knowledge of stock. A further reason for reconsideration is the entrance of a new factor into the great grass question of New Zealand—the factor of top-dressing, a method probably still in its infancy.

I confine myself to Tutira because of an intimate acquaintance with it during forty-seven years, but like processes are at work on every acre of grassland throughout the Dominion. If the reader chooses, Tutira can be magnified with but slight qualifications into Hawke's Bay, and Hawke's Bay into the North Island. Though nowadays but a tenth of the old-time Tutira is in my possession, yet for the purposes of this article the larger original holding will be considered. The lands under review lie midway between Napier and Mohaka, on the Napier–Gisborne road; the hills are limestone, conglomerate, and sandstone; the soils are of every quality, from best to worst; the whole area has been thickly blanketed with waterlaid volcanic grit; in addition it has been dusted with wind-borne pumice to a depth of 3 in. or 4 in. Excepting in regard to alluvium, this rule holds—flat country, bad; steep country, good. From the latter the volcanic grit has been blown or washed or has slipped away.

Before 1879 a small portion of Tutira had taken grass—enough, at any rate, to justify the title of a "fifty-year turf"—but in 1882, when I first set foot on the station, the vast bulk of the run was still clothed in bracken, tutu, light bush, and rimu, white-pine, and totara forest. English grass was then confined to strips beneath the old limestone sea-floors, to minute sheep-camps, to pig-rootings, and Maori clearings. Seed had been carried to these spots by wild stock—wild cattle, horses, and sheep. Patches here and there had been established of alien species by alien animals.

Native grasses before 1879 subsisted in even smaller quantity. Had danthonia or *Microloena stipoides* (New Zealand rice-grass) ever thriven as weeds on the plots of fertile ground intensively worked by the Maoris they were not discoverable when the white man took possession. It sounds incredible, but as late as 1882 danthonia was a very rare grass, so infrequent that I remember noting with interest a few clumps gone to seed on a certain spot on the old pack-trail through Tangoio, and on another occasion pausing to inspect a

flourishing single plant, also in seed, on Tutira. Later a few specimens began sparsely to appear on trampled soil in the vicinity of deserted pas and kaiangas. This absence on Tutira of a grass now so widely spread must, I think, be ascribed to two causes. The first was that danthonia is not a rich-land grass; until the first flush of fertility had been consumed by rye-grass, clover, and cocksfoot it was not at home on the limestone area. The other reason was that on the great central sandstone and conglomerate trough of the run there was literally no room; bracken ran to the very edge of the cliffs, it extended to the very brim of the bogs. In another way—a very remarkable way, and a way that on unhandled country still persists—did *Microloena stipoides* hang on, so to speak, by teeth and eyelids. In these far-off days there were to be seen certain infrequent roundels of nakedness—ringworm patches, as it were—in the tall bracken of the sandstone and conglomerate area. They were doubtless the result of some fungoid disease in the rhizomes of the bracken, and on them *Microloena stipoides* survived in miserable fashion, together with the foreigners *Briza minor* and *Aira caryophyllea*.

In my paper of 1908 the outward signs of the lessened fertility of the surface soil were noted. They were the visibly thinner proportion of rye-grass and white clover, the decreased carrying-capacity of the acreage in grass, the lessened root-penetrative power of English grass-seed. There needs no amplification or repetition of these facts, but further proof of the same tendency between 1908 and 1929 is afforded during that period by the negative results of the turfing and grassing of the cold, damp, southern and eastern aspects. In 1908 three-quarters of such ground was still practically unused; now, owing largely to cattling and fencing, it has come into grass, yet there has been no corresponding increase of stock, no corresponding increase of wool; at the best matters have remained *in statu quo*. To reiterate, while 50 per cent. more ground has become available for stock, no increase of stock has taken place. This great spread of grass area has enlarged the sum total of food value by nothing. In spite of the added grass surface, the aggregate of grass-blades throughout the year has not augmented.

In my former paper occurs the following sentence: "For many seasons the station has passed successively through the phases of rapid increase, slight increase, balance, decrease, and lately rapid decrease." Since then—since 1908—the carrying-capacity of Tutira has remained stationary, the grassing of the colder, wetter portions just about counterbalancing the lessened exuberance of the turf elsewhere. The inability to strike of surface-sown English grasses even prior to 1908 has been touched upon. It is more marked now than ever. After felling and firing the manuka which still persists on the lighter soils, experience has shown the absolute futility of seed sowing. Such lands will grow danthonia, *Microloena stipoides*, suckling clover, *Festuca myuros*, and clustered clover, but for years they have been rye and clover sick. Spring, too, has been postponed from mid-August to September or later. The deepening green of the warm hillsides, the stir of the innumerable pointed blades which used to mark the turn of the shepherd's year, are now retarded by eighteen or twenty days; the primal exuberance of the turf is gone.

Foreign Grasses.

Twenty-one years ago, of the thirty-four foreign species of grass known to me on Tutira, only nine or ten had first touched land by the deliberate will of the owner; the others had reached the run as stowaways. Now these stowaways come at longer intervals. During the last twenty-one years, indeed, only three additional grasses have thus colonized the station—namely, *Glyceria fluitans* (sweet floating-grass), *Poa trivialis*, and *Eragrostis Brownii* (bay-grass).

Though but a few of these aliens require comment here, the full list may be recorded again as follows: *Paspalum dilitatum, Panicum crus-galli, Setaria viridis, Phalaris canariensis, Anthoxanthum odoratum, Phleum pratense, Alopecurus pratensis, Polypogon monspeliensis, Agrostis alba* (Bentham and Hooker), *Holcus lanatus, Aira caryophyllea, Cynodon dactylon, Briza minor, Dactylis glomerata, Cynosurus cristatus, Poa annua, Poa pratensis, Festuca elatior, Festuca ovina, Festuca rubra, Festuca myuros, Festuca bromoides, Bromus mollis, Bromus racemosus, Bromus unioloides, Lolium perenne, Lolium italicum, Agropyrum repens, Hordeum murinum, Sporobolus indicus*, Johnson grass.

Paspalum is of little local value—frosted in autumn, and unnecessary in summer because of our big rainfall. In unmanured pumice, however, though root-bound, it will persist for years, and in that same pumice, worked but still unmanured, will revive and make a temporary show. *Anthoxanthum odoratum* (sweet vernal) has in half a century not moved 400 yards from its birthplace; there has been no attempt at colonization elsewhere on the station. *Phleum pratense* (timothy) has never spread from one or two self-chosen spots on dampish peat. *Alopecurus pratensis* (meadow foxtail) I have not seen locally for years.* *Holcus lanatus* (Yorkshire fog), once an important grass on Tutira, yearly becomes more scarce; on top-dressed pumice, however, the plant is by no means inclined to allow itself to disappear or to suffer domination; during the dry summers of four or five years ago, when on certain light lands almost everything failed from lack of moisture, great clumps of fog survived and seeded freely.

Dactylis glomerata (cocksfoot) still maintains a certain grip on the run, especially on southern and eastern aspects. On deliberately unstocked paddocks even of moderate fertility, if allowed from time to time to run to seed and then to be trampled flat with cattle (supposing there was a single sheep-farmer in the whole of New Zealand great-hearted enough to forgo the immediate gluttonous grazing of his grass) cocksfoot would, I believe, often resume possession. On the other hand, facing the sun—facing north and west—it requires as a companion plant the blackberry. The stubbed, goat-clipped growths just sufficiently shelter its crown, and thus enable it, and rye, and sometimes even prairie-grass, to breathe and live—a curious example, indeed, of plant association: *Cynosurus cristatus* (crested dogstail), which arrived on its own account in very early days, still continues to spread. *Poa pratensis* has specialized in cow-pats, climbing these comfortable cushions until again sinking into reinvigorated flatness.

* Last summer, however, near St. Lawrence, in Hawke's Bay, its tall, soft, silky seed-heads were very plentiful on the enclosed roadsides. *A. geniculatus* I have come across once in my life, in Poverty Bay, inland from Whatatutu.

Concerning *Festuca myuros*, for twenty-one years I have been repenting of my insulting remark that it was almost useless: for twenty-one years I have been trying to live down that unfortunate phrase. On the contrary, the more closely I look into the turf of good, bad, and indifferent lands—the more I dissect scraps of sod—the greater value do I put on the winter growth of this small species. It is a grass that competition has forced to flourish in late autumn and winter: it must grow then or never; given space it spreads its skirts into a delightfully green clump; it fills on the hills every vacant space with innumerable seedlings. If we knew enough we should discover this species fulfilling some important function in the economy of nature. In summer this excellent little annual, known as hair-grass, spindles out to nothing. By October it has bolted into a repulsive series of wiry unappetizing stems; by January it has become as insignificant as the equally important *Trifolium glomeratum*. The immense, the enormous aggregate value of these plants is overlooked because individually they are small.

Until five years ago I had classed *Bromus unioloides* (prairie-grass) as only fit for deep, heavy soils. In the laying-down, however, of a light-land paddock prairie-grass was inadvertently sown with locally saved cocksfoot. This paddock has now been down five years, but instead of dying out prairie-grass has increased. True it is that the field is often spelled and chiefly used by cattle; nevertheless, given a fair show, prairie-grass, up to a point at any rate, will thrive on poor soil top-dressed.

Alas for *Lolium perenne* (perennial rye-grass), which in the "seventies" and "eighties" was sown with quite a childlike simplicity, an infantile faith, on lands good or bad alike. Nevertheless, however much in these degenerate days rye and white clover may have thinned out, certainly for many years and over many thousands of acres they were suited to the virgin soil of our splendid province. I recollect in the middle "eighties" on Tutira the hillsides grey with clover-heads—grey with blossoms where now hardly a leaf can be found by diligent search. Rye-grass, too, has gone except on sheep-camps, and now only is to be found naturally on alluvial flats. Even on sheep-camps—heavily manured sheep-camps—rye in dry seasons no more than holds its own against danthonia. There, as elsewhere, the surface has changed from sponge to slate.

The manner of arrival of rye-grass on Tutira is a proof of the distances seeds were carried by neophytes and scholars from the mission stations of early times. Ripora, afterwards the mother of my friend Aparahama Anaru, was as a girl educated at the Bay of Islands. She it was who first brought rye-grass to Tangoio, about 1834 or 1835. It had been gathered at Paihia, either from one of the newly sown missionary fields or saved from plants that had already spread about the Native quarters. Stowed away safely during the overland march, guarded from salt water during the long canoe voyage south, on arrival neglected in the whare at Tangoio, the cloth of the containing bag rotted and torn, the once treasured seed was finally flung out in forgetfulness. There, falling on fertile soil, it germinated, like the rice and barley cast forth by Robinson Crusoe before the entrance of his cave. The exact manner of its ultimate arrival at Tutira can only be surmised, but probability points to the equine

stomach. It is curious to reflect that this, the most valuable grass in the province, should have reached Tutira long before the run was taken up, and years before a grain of grass-seed had been purposely sown on the station.

Poverty Bay rye-grass is also directly descended from missionary sources. The late Mr. J. N. Williams has told me it was first noticed shortly after the shipment of a couple of cows from the Bay of Islands to the later-established headquarters of the mission on the Waipaoa River. Mr. Williams's brother, the late Bishop of Waiapu, has informed me, too, how rapidly it killed out the native *Microloena stipoides*, then in possession of the whole of the Poverty Bay flats.

Lastly we come to *Sporobolus indicus* (ratstail), one of the two grasses that on the poorest pumice grit in pre-superphosphate days completely clothed it and formed a palatable sward. This it is enabled to do by its enormous depth of root. These roots I have photographed 24 in. long. Owing to the heavy cattling of the run nowadays, ratstail has of late spread more slowly. It does, however, still increase, for during summer stock feed lightly on the least good land. There year by year its scrubbing-brush patches expand. It germinates badly, and on light soils, because of its toughness, is pulled out wholesale.

For Chewings fescue, also, I must say a good word. I respect rather than love the plant. Chewings, nevertheless, and ratstail are the only species that in pre-super days were able to closely and densely carpet pumice-lands.*

Clovers.

Of members of the pea-flower tribe grazed by stock the following had established themselves before 1882: Nonsuch clover (*Medicago lupulina*), toothed burr clover (*M. denticulata*), spotted burr clover (*M. maculata*), field melilot (*Melilotus arvensis*), white clover (*Trifolium repens*), suckling clover (*T. dubium*), red clover (*T. pratense*). Between 1882 and 1902 three additional species appeared: Haresfoot clover (*Trifolium arvense*), alsike (*T. hybridum*), hop trefoil (*T. procumbens*). After 1902 I have noted the arrival of the following: Reversed clover (*Trifolium resupinatum*), strawberry clover (*T. fragiferum*), clustered clover (*T. glomeratum*), suffocated clover (*T. suffocatum*), trigonell (*Trigonella purpurascens*), and striated clover (*T. striatum*).

Some of these, such as spotted burr clover and field melilot, are either actually distasteful or not particularly palatable to stock. Others are in the leaf aggregate of trifling import. Nonsuch, though an excellent plant, is not suited to open or poor soils. Toothed burr clover, hop trefoil, and reversed clover are rarely seen. Strawberry clover grows only on insignificant areas of sandy silt; suffocated clover, though I believe it would thrive, has so far been represented by one single specimen. Trigonell has but recently appeared—a small patch skinned bare to the very roots by sheep.

An interesting fact regarding these clovers is that, with the exception of red clover, all of the sixteen species enumerated have arrived "by

* There are large stretches of Tutira, now out of my hands, which still, after eleven years of no manure, are deeply green in Chewings fescue and subterranean clover.

themselves," for both white clover and suckling were on the station long previous to the earliest sowing. I mean that in the first place they have not been purposely scattered on the hills by man. They have reached the run, so to speak, by their own scheming: they have been shaken from old sacks; they have smuggled themselves on to Tutira among purchased grasses; they have been carried in the stomachs of stock. Afterwards some of them—as also others mentioned elsewhere, such as subterranean clover and several *Lotus* species—have deliberately and on a great scale been distributed over thousands of acres.

Native Grasses.

Following are the native grasses found on Tutira: *Isachne australis, Microloena stipoides, Microloena avenacea, Hierochloe redolens, Echinopogon ovatus, Deyeuxia Forsteri, Deyeuxia quadriseta, Dichelachne crinita* and var. *intermedia, Deschampsia caespitosa, Trisetum antarcticum* and slender form, *Danthonia semiannularis, Danthonia pilosa, Arundo conspicua, Arundo fulvida, Poa anceps, Poa caespitosa, Poa Colensoi, Poa imbecilla, Agropyrum multiflorum, Agropyrum scabrum, Asperella gracilis.*

We can follow in a few paragraphs their history during the last twenty-one years. Danthonia must be considered first of all. Certainly on the hard and ever-hardening hillsides, and especially on the hotter aspects, this species now dominates the land. From a few plants here and there in 1882, surviving on trampled Maori tracks and pa sites, it has developed into the most prominent grass on the station. I write now, as I wrote in 1908, not sure which is the type *D. pilosa* and type *D. semiannularis* and which but varieties. In one good local form the leaves are broad, flat, pilose, and of a notably deeper green. Even twenty-one years ago these grasses had clothed many hundred acres, and since that date there has again been a great increase. In my paper of 1908 there is less said about their value as fodder plants than about their arrival and spread. This signifies, I suppose, that at that date the English grasses were still fighting a rearguard action; they had not yet been in great degree overwhelmed and submerged. Be that as it may, nowadays on all hard soils danthonia has altogether displaced the early-sown aliens, and is also more slowly and more unwillingly thickening on the great spongy centre of the run. It has come to this, in fact, that were stock to be removed for six months nine-tenths of the original Tutira sheep-station would be yellow in danthonia seed-stems.

Microloena stipoides, though enormously more plentiful than in the "eighties," when it too survived on trampled ground and the ringworm roundels described, has remained stationary during the last twenty-one years; land that might have fallen to its lot has been seized by the more virile danthonias.

Of the remaining native grasses found on Tutira, four others only need be discussed. *Dichelachne crinita* grows equally well on hard or soft soils, good or second-class; where spared by stock (as when growing among low bracken) its handsome erect plume of feathery seed-head at once attracts attention. It will maintain itself even on such closely cropped areas as sheep-camps, and was one of the three species growing on the late Mr. J. N. Williams's sample strips of turf collected from the finest Hawke's Bay pasturages and replanted for

observation purposes on the fertile Hastings plains. Thus to survive amid English grasses on rich soils argues an abundant vitality. When trying out various natives in my experimental garden *Dichelachne crinita* reached the height of 5 ft. 6 in., the seed-stems standing erect like fine-drawn straw.

Poa anceps has certainly not fulfilled the prophecy that it is one of the native species which would eventually take possession of certain recently fired lands. Though in the "eighties" it covered very sparsely several hundred acres of accidently burnt rimu forest, it was soon smothered by bracken, and has now in this locality long disappeared. On country of 2,000 ft. and upwards it is, however, an important factor in the turf. Its growth and appearance is that of a very strong broad-leafed *Poa pratensis*.

Poa caespitosa, though locally of no account as a fodder plant, is interesting because it at one time covered several hundred acres on the higher inland area of Tutira. It had, however, even in 1882 been almost destroyed by the starving merino wethers that then ran on this country. The Heru-o-Tureia Block on which it flourished must have been the limit of its eastern spread from the Taupo plains, which, though now brown and red with other growths, were originally yellow with Poa tussock. Brown-top (*Agrostis tenuis*), purposely sown, has of late years taken possession almost exactly of these low rolling tops and flats once occupied by *Poa caespitosa*.

What I termed in my paper of 1908 *Agrostis alba* (Bentham and Hooker), and which should be *Agrostis palustris* (E. Bruce Levy, *N.Z. Journal of Agriculture*, February, 1924) must be exceedingly distasteful to sheep. One small patch existed, and probably still exists, on the heights of the Maungahararu Range. Even in the stock-starvation days of old no beast would nibble it; summer and winter, rank and untouched, it was visible chains distant. A later arrival by scores of years—a form probably of this worthless species—has proved equally unpalatable in paddocks once in turnips; no stock will touch it under any circumstances. The purposely sown *Agrostis*, however, that has thus after fifty years become heir to the Poa tussock, is Levy's *A. tenuis* (*Journal*, February, 1924). On this infertile gritty soil it has behaved precisely as he describes—it has become "inclined to dry out in the summer and get sodbound, so that the yield becomes very low." But although a half-starved species cannot but appear a failure, at any rate no grass that I can think of would have done better. Brown-top, under whatever designation sold and bought, was never sown on the limestone ranges of Tutira: on them to this day, indeed, it is not prominent.

Agropyrum scabrum and *A. multiflorum* may be for the purposes of this paper treated as one. This is the Canterbury blue-grass, credited in the Mackenzie Country and elsewhere with great fattening-qualities, the seed so oat-like in quality that horses taken straight from the paddock could be galloped hard, nay, for miles raced without injury ("Tutira," p. 104). So highly was this grass valued that over sixty years ago seed was sent to Messrs. Sutton in England; nothing, however, was to be learnt of their experiments when I wrote for information. Sheep are fond of the noticeably blue blades, for only

on rough and unstocked lands do they show up. Everywhere throughout Hawke's Bay, on steep road-cuttings or cliffs, do its tall seed-heads call for notice. I think it probable, however, that the great fattening-qualities ascribed to it in the Mackenzie Country lie in the seed rather than the blades. Twice I have planted or sown considerable plots of *Agropyrum multiflorum*—the better plant of the two—and twice accident or ill fortune has marred the experiment.

General Observations.

Such are the grasses and fodder plants, native or foreign, sown deliberately or coming as stowaways, that make up the Tutira turf. Were the limestone hill ranges in imagination dissected horizontally and sheep-camps excluded, species and forms of danthonia would be found covering 75 per cent. of the tops and higher slopes; here and there, looking on to the sun, ratstail is established; rye-grass and white clover have almost disappeared; a little cocksfoot and fog survive in the damper spots; *Poa pratensis* holds; *Festuca myuros* is thick everywhere, also *Trifolium glomeratum*, an equally early-flowering plant with the invaluable, ubiquitous suckling clover (*Trifolium dubium*); *Microloena stipoides*, though dominated by danthonia, is still widely distributed; crested dogstail fully holds its own.

Crested dogstail, suckling clover, and *T. glomeratum* till December supply, I imagine, the condition of the stock, the other plants not more than maintaining them in good store order. There are to be found also in this type of turf *Pelargonium australe*, four species of *Geranium* (*scssileflorum*, *microphyllum*, *molle* and *dissectum*); sorrel; hawkweed; two late arrivals, *Linum gallicum* and *Galium parisiense*; *Wahlenbergia gracilis*; *Carex Colensoi*; pearlwort; *Vittadinia Australis*; a harmless creeping St. John's wort; *Linum australis*; chickweeds; *Cotula*; and certain thistles.

On the lower portion of the range, below our imaginary line, will still be found—though thin indeed compared with early days—rye, white clover, cocksfoot, and fog, more *Poa pratensis*, more ratstail, a stronger growth of crested dogstail, more plentiful suckling, and *T. glomeratum*. Thistles also will be more numerous. Generally speaking, in fact, the damper, heavier soils hold the better grasses for the longer period.

It is perhaps worth while pointing out here that although one of the three *Lotus* species sown on ploughed and supered ground has flourished exceedingly, I have not yet noticed even a single seedling of it on the hills. This is the more remarkable, for the small seeds of *Lotus hispidus* must be carried afield in tens of thousands in the stomachs of shifted stock. Burnet, though persisting for season after season in ploughed land, has never strayed farther.

Subterranean clover, though holding well throughout seventeen or nineteen seasons of neglect on poor unsupered lands, makes no attempt at colonization.* Subterranean clover, which I have seen only

* In its company, by the by, has appeared a very worthless looking, hard, stubby, stemmy fellow-member of the *Trifolium* family, evidently near enough in its seed similarity to pass itself off as the genuine article; it has failed to maintain itself.

as a miserable weed wild on the Sussex coast, offers a shining example of the importance of allowing no vegetable species to perish. Under new conditions it is impossible to predict the potential value of a plant.

To reiterate: Fifty years ago the limestone and papa portion of Tutira was sown in rye-grass, white clover, and cocksfoot; now 75 per cent. of it is in native grasses and inferior aliens. On the conglomerate and sandstone formations fog, goose-grass, and suckling formed the original mixture; nowadays on hills of this quality danthonia rules, with suckling clover second in command—for the wonderful merit of this latter plant lies in the fact that, far from decreasing after half a century's grip of the ground, it persists with pristine exuberance.

The important plants have been sufficiently emphasized. To obtain an absolutely accurate conception of the station turf the intelligent reader has but in imagination to scatter very sparingly according to aspect and soil the additional species listed, and he has the exact value of the present grasslands of Tutira.

As on the Downs in England or on the grassy hills of the Scottish borders, a condition of stable equilibrium is being approached. On Tutira, as in Britain, similar conditions have produced or are producing similar results; in both, the lands in question have been wooded, have later been stinted of leaf-mould for centuries, have been drained of the original mineral plant-foods—not present in vast quantities. Normality has been actually reached in the Old Country, and is approaching in such fifty-year turfs as we have been discussing.

Not long ago grass-farmers would have had to content themselves with merely marking time, utilizing to the full deep-rooting species such as ratstail, and self-feeding plants like suckling and *Trifolium glomeratum*. At the best it would have been a dreary business watching the irretrievable deterioration of their pasture lands. Nowadays, with excellent tuition from our New Zealand agricultural authorities and with cheap fertilizers, they can confidently look to a brighter future.

SHEEP FLOCKS IN NEW ZEALAND, 1928 AND 1929.

Size of Flock.	Number of Flocks.	
	Year 1928.	Year 1929.
1–200	5,809	5,551
201–500	6,457	6,364
501–1,000	5,957	6,313
1,001–2,500	5,415	5,975
2,501–5,000	1,606	1,724
5,001–7,500	416	440
7,501–10,000	157	173
10,001–20,000	139	146
20,001 and over	26	26
	25,982	26,712

ERADICATION OF TALL FESCUE.

METHODS PRACTISED IN THE MANAWATU DISTRICT.

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CERTAIN of the highly fertile drained swamp areas of the Manawatu, which were rightly regarded as strongholds of tall fescue (*Festuca elatior*) that had invaded the land in a vigorous manner to the practical exclusion of all other species, have recently been converted into highly productive farms. These farms, under good management, are capable of carrying milking-cows sufficient to return an average production of over 200 lb. of butterfat to the acre, or a corresponding number of ewes or mixed grazing-stock, whereas when the tall fescue was in possession of the land it could not be utilized satisfactorily either for high-class dairying animals or for other wet stock.

The process of converting the land overrun with fescue into land carrying high-class pastures in which rye-grass and clovers are prominent is one of considerable economic importance, particularly in view of the fact that there still exist in the Dominion extensive areas which are invaded by fescue. The essential features of the system of fescue-eradication employed on those Manawatu farms, the present-day appearance of which bespeaks the suitability and success of the methods, may be briefly stated as follows :—

(1) Preliminary destruction of as many as possible of the fescue-plants in possession by turning over the fescue growth with the swamp-plough, and by subsequently cultivating with disk harrows, &c., for the purpose of destroying all possible plants which escape death as a result of the ploughing. There is evidence that the first ploughing-down of the fescue should be carried out as soon as the land is sufficiently well drained to allow of the passage of the implements over it : the ploughed-down fescue clumps decompose more completely in poorly drained than in well-drained land.

(2) Destruction of the countless viable tall-fescue seeds which are in the soil when the fescue-plants in possession have been eradicated, and which would rapidly bring about complete reinvasion by the fescue were they not properly dealt with.

(3) Prevention as far as possible of the introduction of further supplies of tall-fescue seed at any stage during the time the original fescue-plants and fescue-seeds are being destroyed. If the introduction of further supplies of seed is not avoided, the work of completely ridding the land of fescue is indefinitely prolonged.

There are thus three objectives : (1) the destruction of established plants, (2) the destruction of seeds or of young plants arising from these seeds, and (3) the prevention of reseeding. Persistent trouble with fescue arises more often from failure to give proper attention to the second and third objectives, which are the seemingly minor ones, rather than from failure to achieve the first objective—the apparently major one.

The system of control under consideration not only rids the land completely of fescue, but also brings in such cash returns as to pay for itself as it proceeds. Hence eradication can be carried out without

the direct outlay of additional capital. It is neither possible nor desirable to give a detailed description of this system indicating how it should be applied in all cases. This is because the system is usefully made to vary from farm to farm according to many circumstances, chief of which possibly is the financial position of the farmer operating it. Usually the farmer can easily work out the detailed application of the system suited to his own circumstances once he knows the important and essential steps in it.

The important and essential points in the system under consideration are—

(1) Removal of timber as completely as possible is the first step after drainage, and this should be affected at least to such an extent as to allow of cultivation being satisfactorily carried out. At times, over extensive areas yet to be reclaimed from fescue domination, the removal of timber will prove a formidable task which will tax the labour and financial resources of those engaged in it. However, it is difficult to see how land can be economically and permanently cleared of fescue unless so little timber remains that satisfactory cultivation is possible.

(2) The next step is swamp-ploughing, which calls for the use of a tractor or a six-horse team, and for the turning of a furrow 18 in. wide. The aim should be to turn over and bury as much as possible the crowns of the fescue clumps. The complete turning-over of the clumps may be facilitated by grazing back the growth until only the crowns of the clumps remain. Steers may satisfactorily be employed in grazing back the growth if they are crowded on the fescue for a short period, then grazed for a spell on growth free from ergot, then returned to the rank fescue for another short period, and these changes with the steers repeated until only the crowns of the fescue remain. Large tussocks which the plough fails to turn over effectively may advantageously be turned down with a spade. The land having been ploughed should be further cultivated with disk harrows, &c., so as to provide a satisfactory seed-bed for the crop which is to be sown as soon as the seed-bed has been obtained. In working the ground to produce the seed-bed tripods often are preferable to tine harrows or spring-toothed cultivators, which may undo the work of turning down the fescue clumps.

(3) The third step is the growing of a crop which tends to eliminate the fescue. The first crop grown after the fescue has been ploughed down may be a temporary or short-rotation pasture, a cereal mixture such as oats and tares, partridge peas, or one or more of several standard forage crops such as swedes, soft turnips, chou moellier, mangels, or potatoes. It is highly desirable that this crop should have one at least of two characteristics: either it should be dense and rapid in growth so as to exert a smothering effect on invading plants, or it should be of the cleaning class of forage crops which allow of the ready destruction of invaders by intertillage. One of the principal objectives of such a crop is the destruction of fescue-plants which are likely to arise from undestroyed portions of the original clumps or from seed in the ground. Another principal objective is the provision of a crop which will fit in well with the stock or the cash requirements of the farm. For instance, if pigs are being kept on a fairly large scale,

FIG. 1. TYPICAL GROWTH IN NOVEMBER ON LAND INVADED BY TALL FESCUE.

FIG. 2. FESCUE-INFESTED LAND AFTER SWAMP PLOUGHING IN THE SPRING.

This area was previously in the same condition as that shown in Fig. 1. Although it had been disked twice it was still uneven. The mixture of bush and fescue in the background has not as yet received any attention. In clearing this, removal of the timber, both standing and fallen, is the first step.

[*Photos by H. Drake.*

partridge peas sown at the rate of 2½ bushels to the acre may at times be grown profitably; if sufficient pigs to justify this crop are not being kept it could often be replaced advantageously by such a crop as oats and tares. Again, if market prospects and facilities are favourable, potatoes may prove more advisable than mangels or swedes. At all times in the raising of such crops careful attention should be given to the labour resources of the property. The mere fact that a crop is suited to suppress fescue is not a justification for it; it should also be a sound financial proposition having regard to the property as a whole.

(4) If the first crop after the initial ploughing is a suitable one, such as oats or rape, pasture may be sown down with it. Otherwise as soon as the first crop has been removed generally it is found advisable to immediately plough, suitably cultivate to provide a seed-bed, and sow down a seed mixture designed to produce on fertile land a short-rotation pasture. Rye-grass, white clover, red clover, cocksfoot, and timothy are being made the main constituents of such pastures. It may happen, however, that the requirements of a particular farm call for delay in the sowing-down of pasture. When this is the case a second forage crop may follow the first one, but care should be taken that it is of either a smothering or a cleaning type, since the eradication of the fescue is the primary objective.

(5) It is the rule to find that fescue appears in the pasture produced after the first ploughing. It may be expected that eventually the fescue-plants forming the secondary invasion will become so numerous as to make it necessary again to plough and cultivate the land in order to bring about their destruction economically. When this second ploughing becomes necessary the ploughed ground is sown in one of the special forage crops of the cleaning or smothering type already mentioned. How soon the necessity for the second ploughing arises depends on several factors, chief of which are (*a*) the success attending the initial ploughing and the first forage crop as agents of fescue-eradication; (*b*) the type of stock being carried; (*c*) the steps taken, apart from stocking, to check the rate of secondary invasion.

In regard to the type of stock, store cattle such as bullocks or dry sheep which it is not desired at the time to fatten can be made to graze so hard as to punish the fescue, check its development, and markedly delay the date when the second ploughing-down of fescue will become necessary. On account of this there has arisen occasionally the impression that fescue can be eradicated by bullocks or sheep. The true position is that the fescue is controlled but not eradicated. And if the land on which it is so controlled were devoted to dairying or to fat-lamb production the fescue would rapidly assert itself and take possession within a relatively short time. From this it follows that while dry stock cannot be looked to as a means of eradicating fescue, they can at times be made extremely useful in controlling it, until such time as one is in the position to do the ploughing necessary to so free the land from fescue as to make it safe for dairying or for fat-lamb production. In other words, while land is being reclaimed from fescue, mixed stock-farming has much to recommend it, particularly if the farm is one of considerable size.

The rate of secondary fescue invasion can also be checked substantially if time and care is given to the digging-out with the spade of

FIG. 3. FIELD SOWN WITH GRASS IN MARCH, 1928. RIGHT AFTER SWAMP PLOUGHING AND CULTIVATION.

Despite the fact that stray plants of fescue have been removed with the spade, it can be seen that fescue is now fairly prominent, and ploughing will soon be necessary. It is intended to plough the area in March of this year.

FIG. 4. LAND AFTER RECEIVING ITS SECOND PLOUGHING.

In November, 1929, this area was sown in soft turnips in the foreground and in mangels and potatoes in the background. When these crops have been removed the land will be ploughed and sown in pasture which, it is expected, will be permanently free from fescue.

[*Photos by H. Drake.*

as many as possible of individual invading fescue-plants. Indeed, some hold that one ploughing-down of the fescue is sufficient if proper attention is given to the digging-out of invading plants as they appear. This may be true of land which is not of the type that constitutes the real fescue strongholds. But those with experience on the rich drained swamp-land are of the opinion that the eradication of fescue by the digging-out of invading plants, while possible, proves so costly in labour as to be a method of eradication much less desirable than that which involves the extra ploughing as herein described.

An additional aid in checking the rate of secondary invasion lies in the prevention of seeding of all fescue-plants which have established themselves. Prevention of seeding may be accomplished by hard grazing or by the use of the mower to top the plants at suitable seasons.

(6) Even when all practices already referred to have received due attention it is often necessary to plough the land a third time to bring about absolutely complete fescue-eradication. It is impossible to fix when this third ploughing should be carried out, as much will depend on the results of the prior treatment. If farm conditions permit it is well to carry out this ploughing in the autumn, and to precede it by a spring skim-ploughing, followed by regular summer surface tillage with disk harrows, &c. The skim-ploughing and summer surface cultivation greatly facilitate the complete destruction of the fescue.

(7) Once a field has been freed from fescue great care should be taken to prevent the reintroduction of fescue-seed from outside sources. Hence drains and similar places from which fescue cannot readily be eradicated should be fenced along all sides. At times areas so fenced could very advantageously be planted with trees. If suitable trees are used they will not only act as shelter-belts and eventually provide useful and valuable timber, but they will also destroy the fescue in their vicinity by the shaded conditions they create.

(8) Right through all grazing subsequent to the first ploughing-down of the fescue good grazing-management such as would be productive of a close dense sward will materially lessen the trouble from fescue. Hence, as mixed grazing with sheep and cattle admits of better grazing-management than grazing with cattle alone, some of those who have been most successful in dealing with fescue favour the running of some sheep, even though cattle are outstandingly the dominant consideration.

An important feature of the system of fescue-eradication herein described is that it may be made to vary greatly according to the circumstances of the farm and of the farmer operating it. It may be so greatly varied that it can truly be said to be characterized both by flexibility and elasticity. These in themselves are valuable merits, in that their presence means that one is not bound to any cast-iron routine, but may bring in any modifications from time to time that market conditions call for. For instance, special forage crops have to be grown, but the suitable crops are so wide in range that one could swing from beef-production to sheep-production, to butterfat-production, to pig-production, as replacements of or adjuncts to one another, while the process of fescue-eradication was being effectively carried out.

The outstanding considerations in respect to this system of fescue-eradication are—(1) It has proved in practice to be effective, (2) it finances itself, (3) it is highly elastic and flexible, and so it can if necessary be greatly modified to meet unforeseen market developments.

It is a pleasure to record my thanks to those farmers who readily and carefully gave me valuable information in regard to their actual experience in fescue-eradication. In this connection I would specially

FIG. 5. FIELD CLEARED OF TALL FESCUE AND NOW CARRYING A HIGH-CLASS CLEAN PASTURE.

This pasture is expected to remain permanently free from fescue. It has received three ploughings: in 1926 it was ploughed and sown in swedes; in the spring of 1927 it was ploughed and sown in oats; early in 1928 it was ploughed after the oats, and sown immediately in permanent pasture. [*Photo by H. Drake.*

mention Mr. S. R. Young, of Opui, whose farm as it stands to-day is a testimony to the success of his methods. A feature of particular interest attaching to the accompanying photographs is that they depict the stage various measures of fescue-eradication had reached on Mr. Young's property towards the end of November last.

Finally, it must be remembered that the foregoing matter applies particularly to tall-fescue land in the Manawatu, and may not be suitable for other districts where fescue is infesting different types of soil.

Actinomycosis in Cattle.—The animals condemned for this disease and for which compensation was paid in 1928–29 were 685, as against 628 the previous year, distributed as follows: Canterbury, 63; Auckland, 380; Wellington, 182; Otago, 60. In addition to those animals slaughtered for the disease a considerable number were treated with potassium iodide with satisfactory results. The annual report of the Live-stock Division states that only in open cases or in those which have advanced so far that treatment is useless is slaughter carried out, and wherever possible owners are advised to seek advice early, in order that the best results may be obtained and that the lives of valuable animals may not be sacrificed.

PARTURITION IN BOVINES.

(Concluded.)

J. LYONS, M.R.C.V.S., Director of the Live-stock Division, Wellington.

Malpresentations—*continued.*

All Four Legs presented.

This is a case where delivery is easily effected when it is in the hands of the skilled operator, although it can be made a very difficult one by undue interference. To effect delivery the operator should make certain which are the fore and which are the hind legs. This is easily accomplished by inserting the hand to discover which are the knees and which are the hocks, and the hind limbs should then be secured by ropes fastened round the fetlocks. The hand should again be inserted and the fore legs pushed back, meanwhile traction being applied alternately on the hind limbs by an assistant and delivery brought about in this way. In a case of this kind, if traction is applied indiscriminately, more especially to the fore legs, the limbs become jammed in the passage, when it will be found impossible to return them to the original position and the only method of delivery with safety to the mother is to remove the fore legs, when, by bringing the hind legs forward over the brim of the pelvis, delivery can be effected. Directions for removing the fore legs were given on page 24 of last month's *Journal*, in connection with the presentation of two legs with head turned back.

Malpresentation of Twins.

In the majority of cases no difficulty is experienced by a twin birth. It sometimes happens, however, that both twins are presented together and become blocked in the passage. In such cases both may be normal presentations, both may be breech presentations, or, what in my experience has been most common, one calf may come head first, while the other is presented tail first.

Whatever is the position, care will need to be exercised that pressure is not applied to those parts presented and the calves jammed further into the passage. The hand and arm should be inserted, and the calf which is farthest into the passage should be selected to be brought away first. The legs should be roped, and care must be taken that the legs belonging to the same fœtus are secured. This can be done by following each leg right up to its insertion. When the limbs are secured the other fœtus should be pushed back as far as possible and delivery effected.

The other fœtus can then be delivered in turn. A case such as this is rendered more difficult if one or both presentations is not natural. However, every malpresentation should be adjusted as with a single birth before attempting to bring about delivery.

Other Difficult Conditions.

Dropsy of the Abdomen of the Fœtus.

It sometimes happens that in spite of traction applied by those in attendance delivery cannot be accomplished, although the presentation

is a natural one in every respect. In such a case undue force should not be exercised, and the operator should make an examination to discover the cause of the obstruction. In passing the hand between the wall of the womb and the fœtus it will be found that the belly of

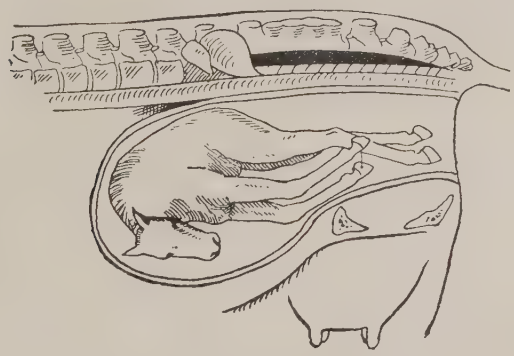


FIG. 5. ALL FOUR LEGS PRESENTED.

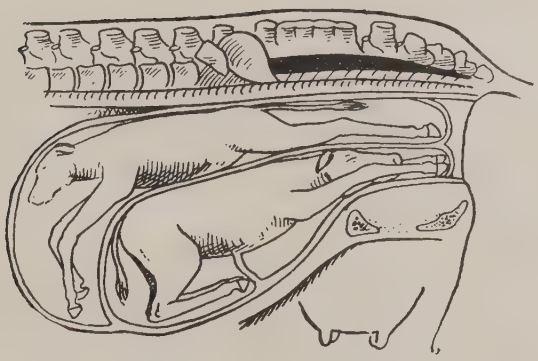


FIG. 6. TWIN CALVES: LOWER, NORMALLY PRESENTED; UPPER, HIND LEGS FIRST. [*After H. Thompson.*

the calf is greatly extended. This can be relieved by opening the cavity with a knife, when the fluid will escape, after which delivery is easily accomplished.

Fœtus with Two Heads.

Considerable difficulty is experienced in delivering such cases, on account of the double head being too large to allow it to be manipulated through the passage. In this case the head must be removed. If

the case has not been interfered with and the fœtus is inside the womb, the head can be removed with an ecraseur specially made for the purpose. Too frequently, however, interference has taken place, when the head becomes firmly jammed in the passage. In such circumstances the hands of the operator should be well oiled and a wire cord introduced around the neck as described in connection with practice in cases of contraction (see last month's *Journal*, bottom of page 27), and the head removed, after which the remainder of the calf can be removed. In a case like this where the head is sawn off, without any covering to protect against the bones, the hand should be introduced and held over the neck until it has reached the outside.

Torsion of the Vagina.

In this case the cow shows all the appearance of calving, but without any sign of the fœtus. In introducing the hand it will be found that there is a twist in the passage. This may be complete or it may be only a partial one. If the former, considerable difficulty will be experienced in effecting delivery, as the passage is completely blocked and does not admit of any part of the fœtus being touched.

In this case the animal must be secured and rolled over on its back to the other side, when the twist will right itself and delivery can be accomplished. While the cow is being rolled over the operator should keep his hand in the passage to ensure that the turning is in the right direction. If the animal is being rolled in the wrong direction the twist will tighten on the hand, in which case the rolling should be reversed.

When the twist is only a partial one the hand can be introduced and the calf's legs secured. It should be the object of the operator to get these through the twist when by a rolling movement the womb may slip back into place, or, as frequently happens, the cow may lie down and in doing so the action causes the womb to slip into its place, when delivery is easily effected. In any case, if when the cow is lying she is pushed from one side to the other the womb will go back into position. Again the hand should be inserted into the passage to ensure that the animal is being moved in the right direction.

Constriction of the Os Uteri.

In this case, as in the one just described, all the signs of calving will be in evidence, but not even the contents of the membrane will appear. On introducing the hand it will be found that the mouth of the womb is closed, or practically so. In this instance the animal should be given a dose of physic made up of 1 lb. Epsom salts to which has been added 2 oz. chloral hydrate or 2 oz. tincture of opium. She should then be put in a quiet place and left alone, when, in the course of twelve to twenty hours, it will be found that the mouth of the womb relaxes and the calf comes away naturally. In a small proportion of cases of this kind it will be found that the mouth of the womb has undergone structural changes and become hardened, which means that there have been structural changes and the parts have become hardened by the addition of fibrous tissue. Such cases will not relax under treatment, and the knife has to be applied and the mouth of the womb cut open before delivery can be effected. Such cases frequently prove fatal.

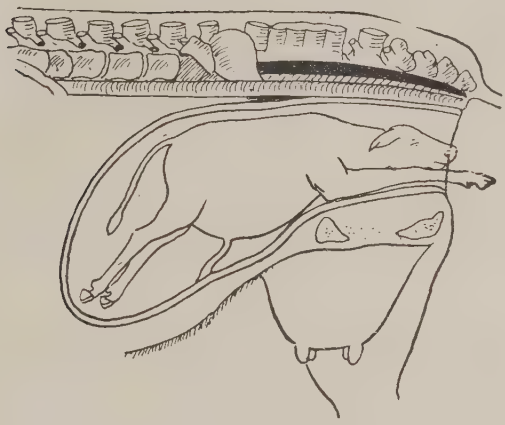


FIG. 7. DROPSY OF ABDOMEN OF FOETUS.

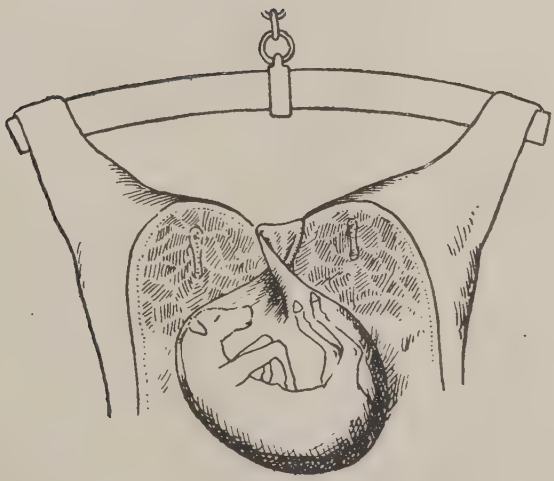


FIG. 8. TORSION OF VAGINA.

[*After H. Thompson.*

Inertia of the Uterus.

The cow although showing signs of calving may make no real effort to do so. She may be seen walking up and down the paddock all day long, switching her tail and frequently lying down without any severe labour pains being in evidence. This is due to want of tone in the muscular coat of the womb. When the hand and arm are introduced the parts will be found intensely relaxed and everything in readiness to come away. In this case the feet should be roped and steady traction applied, and meanwhile the hand of the operator should be kept on the crown of the calf's head so as to direct its entrance into the passage, after which the hand can be removed and delivery takes place. In such cases it is absolutely necessary that the fœtus be removed, otherwise the pains will cease, and if the fluids have escaped a simple calving case is turned into a most difficult one.

HOT-WATER TREATMENT OF SEED BARLEY.

FIELD EXPERIMENTS IN CANTERBURY, SEASON 1928–29.

C. H. Hewlett, Canterbury (N.Z.) Seed Co., Ltd., Christchurch.

It was indicated in the last report on this work (published in the *Journal* for September, 1928) that an attempt would be made during the 1928–29 season to eliminate the smuts from the bulk of the malting-barleys of Canterbury. With this object in view, both the Canterbury Seed Co. and New Zealand Breweries, Ltd., used for seed purposes in their contracts seed "once removed from treatment," and with the advice and assistance of Mr. J. C. Neill, Field Mycologist, Department of Agriculture, the plan was put into operation. Thus about 70 per cent. of the malting-barley crops of Canterbury were produced from seed once removed from treatment.

The following matter presents the practical results of the hot-water treatment of seed barley on 4,331 acres of malting-barley in the Canterbury District, north of the Rakaia River, for last season.

The method of treatment employed was in essentials that of the 1927–28 season—a presoak of five hours in water at 60° to 70° F., followed by a dip of five minutes in water held at 127° F.

Samples were taken for germination, and tests made at the Official Seed-testing Station, Palmerston North, gave the results shown in Table 1. Results for the previous three seasons were published in the *Journal* for June, 1927, and September, 1928.

The crops made splendid early progress in the 1928–29 season, and at the end of November promised a record yield, but about 9 in. of rain fell between 1st December and 7th January, which encouraged rust and completely laid the bulk of the crops, which on the heavy lands were of such luxuriant growth as to be unable to stand up to such an amount of moisture and suffered much more damage than those on the lighter lands. Under these circumstances, the better

Table 1.—Germination Tests.

Variety.	—	Days.										Total.
		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
		%	%	%	%	%	%	%	%	%	%	%
Chevallier ..	Control	..	72	99	100	..	..	..	..	..	..	100
,, ..	Treated	..	13	60	88	92	93	*	95	..	..	95
Plumage ..	Control	..	33	98	100	..	..	..	..	..	..	100
,, ..	Treated	..	15	58	88	*	95	96	..	..	..	96
Archer Spratt ..	Control	..	65	98	99	100	..	..	..	..	..	100
,, ..	Treated	..	13	89	92	94	95	97	..	..	..	97
Goldthorpe Spratt	Control	..	16	*	99	100	..	..	..	..	..	100
,,	Treated	..	9	*	95	97	100	..	..	..	..	100
Plumage Archer	Control	..	32	100	..	..	..	..	..	..	..	100
..	Treated	..	7	49	80	*	89	90	92	94	..	94

* Sunday—Laboratory closed.

the land the worse the crop, both in quantity and quality. Just before the crops started to ripen continuous hot weather was experienced, and the barley ripened much too quickly. Owing to these conditions the yields were much lighter than they would have been otherwise, while the quality of the grain, especially that grown on the heavier lands, suffered severely. However, despite such severe handicaps the yields were good.

As already indicated, acting on the preceding two years' experience of treated seed, the Canterbury Seed Co. and New Zealand Breweries arranged in their barley-growing contracts for the provision of treated seed, consequently 70 per cent. of the Canterbury growers, and nearly all those north of the Rakaia River, used seed once removed from treatment, leaving only an area of about 30 per cent. to be grown from untreated seed, and that mostly south of the Rakaia. Very little untreated seed having been used in the districts where the treated seed was used, comparison is not feasible.

By using the Government Statistician's figures for the whole of Canterbury, however, a certain amount of information can be gained, and the following tables present a condensed summary of the actual results from both treated and untreated seed. Under the heading of "treated" is included both "direct from treatment" and "once removed from treatment." The figures used in this article have been obtained from the product of 4,331 acres of barley grown on contract and sown with treated seed.

In any comparison it is necessary to note that the direct-treatment barley had the advantage of being grown on very good land, probably above the average of that on which the once-removed was grown.

All the seed direct from treatment was grown on the Canterbury Seed Co.'s farms. The drills used were cleaned out and disinfected with a strong solution of formalin; the reapers and binders were treated in the same manner before reaping operations commenced; and the threshing machines were also similarly treated before threshing. This was done with a view to prevent reinfection of the product, so as to enable the seed saved to be used as once removed for sowing

a large area for the following season. The grain-cleaning machines used to clean the once-removed product were also cleaned down and disinfected with formalin.

Table 2.—Yield of Seed Direct from Treatment and Once removed from Treatment (Mill Firsts only).

Variety.	Direct Treatment.			Once removed.			Total.		
	Number of Farms.	Acreage.	Yield per Acre.	Number of Farms.	Acreage.	Yield per Acre.	Number of Farms.	Acreage.	Yield per Acre.
			Bushels.			Bushels.			Bushels.
Chevallier ..	2	45	65·8	31	526	52·24	33	571	53·31
Plumage ..	1	9	60·8	6	83	52·92	7	92	53·69
Archer Spratt ..	2	63	59·5	139	2,862	53·95	141	2,925	54·10
Goldthorpe Spratt	1	10	46·8	14	271	41·31	15	281	41·50
Plumage Archer	1	23	61·2	28	439	56·91	29	462	57·13
Total ..	7	150	60·9	218	4,181	53·23	225	4,331	53·50

Upon an inspection of the crops by Mr. Neill in January, 1929, and again later, it was found that all the product of the seed direct from treatment was absolutely free from smut.

Some of the product of the seed direct from treatment, grown in the 1927–28 season on farms other than the Canterbury Seed Co.'s, as mentioned in the September, 1928, issue of the *Journal*, was threshed through an ordinary mill, and although the mill was cleaned down and disinfected its structure was such that it was impossible to effectively deal with it, and a slight trace of smut was found in a few isolated instances in the product of the once-removed seed which had been threshed through this class of machine. In no case, however, was smut found in the product of treated seed threshed by a mill which had been properly and efficiently cleaned down and disinfected.

The product shown in Table 2 was graded as follows :—

Table 3.—Grading of Product (Mill Firsts only).

[D.T. signifies direct-treated seed ; I R. signifies once-removed seed.]

Grade.	Chevallier.		Plumage.		Archer Spratt.		Goldthorpe Spratt.		Plumage Archer.		Total.		Grand Total.
	D.T.	I R.	D.T.	I R.	D.T.	I R.	D.T.	I R.	D.T.	I R.	D.T.	I R.	D.T. & I R.
	%	%	%	%	%	%	%	%	%	%	%	%	%
No. 1 Grade	100	44·97	..	42·12	..	49·70	..	56·59	..	33·85	32·44	47·53	46·94
No. 2 Grade	..	29·14	100	32·47	35·9	38·22	100	25·90	100	46·63	41·24	37·31	37·47
Undergrade	..	25·89	..	25·41	64·1	12·08	..	17·51	..	19·52	26·32	15·16	15·59
Total ..	100	100	100	100	100	100	100	100	100	100	100	100	100

Table 4.—Comparison of Yields of Canterbury Treated Seed with Government Statistician's Figures.

——	District.	Area.	Yield per Acre.
			Bushels.
Direct-treated and once-removed seed	North Canterbury	4,331 acres ..	53·5 (mill firsts only).
Statistician's figures	All Canterbury ..	9,561 acres (including 4,331 acres of treated)	45·87 (including mill seconds).

Table 5.—Comparison of Government Statistician's Figures for Yields of last Four Years with Yields from Treated Seed.

——	1926.	1927.	1928.	1929.	Threshing.
	Bushels.	Bushels.	Bushels.	Bushels.	
Canterbury (treated only)* ..	..	61·85	60·77	53·50	Mill firsts only.
Canterbury (including treated)	37·51	49·73	48·97	45·87	Including mill seconds.
Marlborough	32·22	35·92	30·57	31·18	
Otago	40·08	34·42	32·31	36·23	

* Seed Co.'s figures.

The year 1926 being the first in which these experiments were conducted, only a small area was sown with seed direct from treatment, and none with once removed, as none was available. After the 1926 harvest the figures were collected for the product of seed direct from treatment and once removed from treatment from the following areas: Harvest 1927, 560 acres; harvest 1928, 1,046 acres; harvest 1929, 4,331 acres. The figures for the later periods, having been compiled from a larger acreage, possess an added value.

Even making allowance for good seasons, the foregoing evidence points to the fact that the greater yield of the Canterbury crops must have been influenced by the attention given to pure strains of smut-free seed during the past few years. Both yield and quality of the crop have been markedly improved, and the growing of this cereal in Canterbury has now been placed on a more reliable and profitable basis. It is significant, however, that the greatest care has to be exercised in order to keep the seed from reinfection, and, as already mentioned (not only in this article but in that published in the June, 1927, issue), reinfection follows from the use of machines inefficiently cleaned or disinfected.

The whole programme of experiments was carried out with the valued assistance and advice of Mr. J. C. Neill, supported by other officers of the Department in various ways. Acknowledgment is also due to Mr. H. Neave, the Seed Co.'s manager at Leeston, who superintended the sowing and harvesting operations, and to New Zealand Breweries for their co-operation.

Experiments have also been carried out on somewhat similar lines with about 1,000 acres of wheat and oats, but this work is not yet far enough advanced for publication of results. Experiments are proceeding during the current season with barley, wheat, and oats as a result of which it is expected some valuable information will be available.

ORGANISM PRODUCING BURNT FLAVOUR IN CREAM OR BUTTER.

STREPTOCOCCUS ISOLATED AT WALLACEVILLE LABORATORY.

G. F. V. MORGAN, N.D.A., N.D.D., Dairy Bacteriologist, Wallaceville Laboratory.

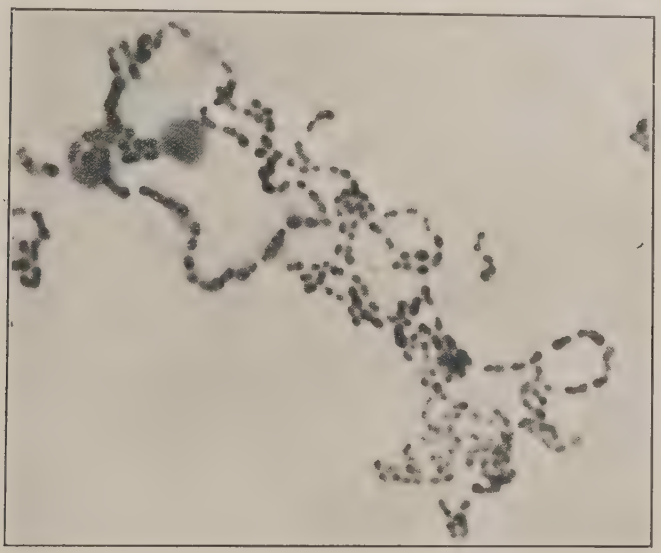
DURING an investigation at Wallaceville of the types of bacteria that resist pasteurization in dairy-factory plants a number of washings from these plants were examined and a bacteriological survey made of the types present in the plant directly after pasteurization was completed. From several of these washings a type of streptococcus was isolated which appeared to be present in certain plants in considerable numbers, forming as high as 30 per cent. of the streptococcus type of colony present in a 1/10,000 dilution. The organism, when cultured in milk and lactose broth, appeared to be similar to *Streptococcus lactis*, apart from the fact that it seemed slightly larger than the usual strains of lactic streptococci found present in milk, and seemed to develop a more marked chain formation, particularly in the early stages of growth.

The writer has noticed when working with raw milks and samples of factory starters received at this Laboratory that the usual virile lactic streptococci commonly found present have a tendency to grow in pairs or short chains of four to five organisms until the maximum acidity has been reached. After a curd is formed and the milk or starter becomes overacid, long chain formation becomes much more marked and seems to increase until the organisms lose their vitality and becomes so attenuated that they lose their power of rapid acid production in subsequent transfers.

This loss of power did not appear to be the case with the streptococcus isolated from pasteurization plants, which developed marked chain formation from its early stages of growth both in milks and broth cultures, and showed no lack of ability or slowness in acidity production. A pure culture of this streptococcus was procured by removing a probable colony from one of the original shake cultures of washing-water, transferring it to 10 c.c. of lactose broth, and adding the whole after culture at twenty-four hours to 1 litre of milk (particular care being taken to flame the neck of the test tube and flask). In this way a starter was obtained from a pure culture of the streptococcus and was examined after twenty-four hours' incubation at 68° F. The curd produced was normal in every way, but the aroma and flavour were totally different from that produced by *S. lactis*, having a very decided burnt or caramel flavour. This starter was subcultured regularly for two weeks, and maintained the burnt flavour without change or abatement. (It may be mentioned here that after the first appearance of a burnt flavour the milk used for cultivation was sterilized for three successive days at a little below boiling-point, so that any chance of charring the milk before cultivation was avoided.)

A pure culture of *S. lactis* (commercial starter organism) was obtained from Mr. H. R. Whitehead, of the Dairy Research Institute,

and the two types of streptococci were cultivated under identical conditions for two weeks, the flavours of both types remaining identical and distinct. In addition to this, the cultures of *S. lactis* and the flavour-producing streptococcus were grown in duplicate in 500 c.c. quantities of milk, and incubated for twenty-four hours at 68° and 98½° F. The results were as follows: At 68° over a period of one week *S. lactis* produced a normal starter curd with a clean acid flavour and no indication of a slowing of acidity-production. At 98½° the first culture appeared normal in texture and flavour. As the week progressed the starter took considerably longer to incubate, producing a sharp acid flavour, and soon showed signs of wheying off after coagulation and shaking; at the end of the week it was practically



PHOTOMICROGRAPH OF THE FLAVOUR-PRODUCING STREPTOCOCCUS.

dead. The flavour-producing streptococcus at 68° produced acidity slowly, with burnt flavour pronounced, but not as pronounced as that produced at 98½°; the curd was normal. At 98½° the rate of acidity production increased, and the burnt smell and taste became very pronounced. There was no sign of decreased acidity-production or attenuation at the end of a week.

During the time the experiments on direct cultures from milk to milk were being carried out several cultures were taken of the flavour-producing streptococcus and passed through casein agar and lactose broth into milk again, when the same burnt flavour was produced. As this particular strain was originally so predominant among the streptococci found present in pasteurization plants it would appear to have

considerably greater heat-resisting powers than the ordinary lactic streptococci. This is also borne out by its ability to maintain its virility at high incubation temperatures. Several flasks of starter of this strain were flash-pasteurized in the Laboratory to 165° F., and cultured at 98½° on casein agar plates from dilutions of 1/1,000,000 and over of the starter. The resulting cultures showed a large surface growth of streptococcal colonies, though not as large a growth as would have appeared if all the organisms had survived. When these colonies were removed and passed via broth into milk again the burnt smell and flavour typical of this organism was further intensified.

Significance to the Buttermaker.

After these experimental results had been obtained with starter it was considered important to determine the significance of this type of streptococcus to the buttermaker, more particularly with regard to the "peanut flavour" common in Auckland District. To this end 1 litre of cream was ripened with the flavour-producing streptococcus, and a control with *S. lactis*. In the first case the cream developed the typical burnt flavour, which was carried over into the butter and seemed to be accentuated rather than diminished by salting. (On keeping in cold store this flavour held but did not increase.)

A more extensive experiment was then carried out in which 12 litres of fresh cream of low bacterial count were measured out into twelve sterile 2-litre flasks; six of these flasks were sterilized and the other six left untreated. A series of these sterilized flasks were inoculated with the flavour-producing streptococcus and three with *S. lactis*, and were allowed to ripen to acidities of 0·15, 0·25, and 0·4. These creams were then churned in the flasks in which they were ripened, and worked under practically sterile conditions. All the butters made from cream ripened with the flavour-producing streptococcus had the same markedly scorched flavour to about an equal degree, in spite of the variation of acidity. The remaining six flasks were inoculated with an equal quantity of the two starters in the same manner as the first series, only the cream was at no time heated or sterilized, and the normal bacterial flora was allowed to develop as the ripening process continued. The same acidities were developed as in the first series, and gave the following results: The flavour-producing streptococcus developed a marked flavour at 0·15 and at 0·25 acidity, but at 0·4 acidity a rancidity due to the presence of an excess of coliform organisms was by far the most predominant flavour.

In the three flasks ripened by *S. lactis* and sterilized, and in the three flasks of raw cream ripened with the same starter, the flavours were clean and palatable, except in the cases of raw cream ripened to 0·25 and 0·4 acidity, the former having an uncertain flavour, and butter from the latter being decidedly objectionable.

A broth culture of this streptococcus was forwarded to Mr. Whitehead, who tested in starter form and ultimately in cream and butter. He reported as follows: "When 2 per cent. of culture was added to the cream the butter had a most marked and objectionable caramel flavour (the cream also had this flavour before churning). When 0·1 per cent. of culture was added to the cream no flavour was detected in the butter one day old."

This particular strain of lactic streptococcus may be of considerable importance to the buttermaker, as it has been frequently noticed at this Laboratory in samples of washing-water from pasteurization plants, both in cheese and butter factories. The possibility exists that in a number of cases scorched flavours in butter are due to streptococci of this type, and not to pasteurization at too high a temperature as is usually supposed.

Classification of the Organism.

Considerable study has been made in the past of various strains of lactic streptococci, among which *Streptococcus thermophilus* (Orla Jensen) has been isolated. The streptococcus isolated at Wallaceville compares fairly nearly to this strain, but differs in the following characteristics: Though a heat-resisting streptococcus it has not the same ability to resist high temperatures as *S. thermophilus*; it has not the same characteristics in reduction of litmus milk, and over a series of sugar reactions has never shown an ability to ferment sucrose, though the other sugar reactions typical of *S. thermophilus* were identical over a series of tests for one week. This was surprising in so far as the sugar reactions of the streptococcus group are frequently very irregular.

The sugar reactions of *S. thermophilus*, the streptococcus isolated at Wallaceville, and *S. lactis* respectively are indicated in the following table:—

	S. thermophilus.	Flavour-producing Streptococcus.			*S. lactis.*
		First Day.	Second Day.	Third Day.	
Dextrose	+	−	−	+	−
Laevulose	+	+	+	+	−
Mannose	+	−	−	+	+
Galactose	+	−	+	+	−
Sucrose	+	−	−	−	*
Lactose	+	−	+	+	+
Maltose	+	+	+	+	−
Salicine	..	..	..	..	+

* Doubtful.

The series of sugars shown above gave constant reactions with the flavour-producing streptococcus, showing a distinct similarity to those sugar reactions of *S. thermophilus*, apart from its inability to ferment sucrose. It is considered that acidity-production is uncertain in maltose with cultures of *S. thermophilus*. In the case of the streptococcus isolated at Wallaceville maltose was always readily fermented. Its action on litmus milk was identical with that of *S. lactis*, and did not show the partial reduction of litmus typical of *S. thermophilus*.

Conclusions.

The organism isolated at Wallaceville appears to be a distinct strain of *S. lactis*, having an increased ability to resist heat and a marked ability to create scorched flavours in cream, milk, or butter. This organism is not identical with any of the flavour-producing types

of streptococci previously isolated, but appears similar in most of its sugar reactions to *S. thermophilus* (Orla Jensen) as classified in Bergey's "Manual of Determinative Bacteriology."

The organism is probably present to some extent in a number of milk and cream samples, together with the ordinary strains of lactic streptococci. If it is present in the raw milk to any extent it is possible that pasteurization, by destroying the less heat-resisting streptococci, may thereby increase the proportion of this flavour-producing type. This possibility is of particular importance in starter milks, particularly in butter-factories.

The possibility exists that this type of lactic streptococci may be responsible for a number of samples of butter having a scorched flavour that had hitherto been attributed to overpasteurization of cream. In this connection it is interesting to mention that when cream has been autoclaved in this Laboratory for the purpose of obtaining a quick and thorough sterilization, and therefore taken to a much higher temperature than could be obtained in the factory, no definite charred flavour has resulted in the butter made from the cream and ripened with *S. lactis*.

STRATFORD DEMONSTRATION FARM.

NOTES ON OPERATIONS IN 1928–29 SEASON.

J. M. Smith, Chairman of the Farm Committee.

The weather conditions experienced in the Stratford district during the year ended 31st July, 1929, were favourable for farming, particularly as regards pastures, although a short dry spell during the early autumn necessitated a start being made on the winter reserve of fodder at the Demonstration Farm.

At the close of the preceding year the last of the clearing, stumping, and breaking-in had been completed on the farm; so that during the season under review the work carried out was chiefly in connection with pasture management, and cropping was reduced practically to a minimum. The farm is now in line with the majority of dairy-farms in the coastal and central districts of Taranaki, in that breaking-in has been completed and pasture management is now receiving major attention.

Whether supplementary fodder cropping can be entirely dispensed with under the existing conditions is a matter of conjecture, but there is no doubt that by proper pasture management—in the direction of bringing the feed away earlier in the spring, prolonging the growth further into the winter, and increasing the growth during the flush period—the herds can be well treated with a smaller acreage of supplementary fodder crops than has been the case in the past. The more thorough cultivation and attention to these crops has no doubt meant in recent years that a bigger tonnage has been taken off a smaller area, and this in no small degree has resulted in a smaller area being under the plough; but the biggest factor in the reduction of the cropping area has certainly been our increased pasture-production,

following better management in the way of top-dressing, grazing, and harrowing. It is the intention of the farm committee to see just how far we can go towards eliminating cropping without in any way reducing our butterfat-production or making that production economically unsound.

During the season, of the 142 acres comprising the farm, only 9 acres were under the plough, and on this area none of the crops grown were for autumn feed. An area of 3 acres was in mangels, 1 acre in carrots, and 5 acres in autumn-sown oats for early spring feed. Hay was conserved from 14½ acres, and ensilage made from 25 acres. Of this 25 acres it was originally intended to save 8 acres for hay, but owing to unfavourable harvesting weather during January it was decided at the last minute to make this area into ensilage, and although it was recognized that the crop had gone past its best stage for ensilage-making it was felt that a second-class ensilage was preferable to an inferior bleached hay.

Pastures.

An abnormal growth brought about by the very favourable growing-conditions experienced at Stratford, in common with other districts, during the late spring and early summer, and it was found necessary to run the mower over the whole of the pastures. This "topped" material was saved as hay, as there was a considerable amount of it, and the pastures were thus kept controlled and in a young growing condition.

Realizing the losses that occur due to faulty seed-mixtures in the laying-down of permanent pastures, the committee is working in close co-operation with the Agrostologist of the Department of Agriculture (Mr. E. Bruce Levy) in connection with the sowing of truly permanent and suitable grasses. A series of pasture trials was established in the spring of 1928, and some valuable data have already been obtained.

The standard top-dressing trials commenced previously have been continued, with interesting results. Most of the new trials have been on the use of nitrogenous manures. To test the value of sulphate of ammonia, as a manure considered of great value in bringing away early feed and prolonging autumn growth, two paddocks were selected which were identical in every respect. One of these paddocks had at different periods, in addition to the ordinary phosphatic dressings, four separate dressings of sulphate of ammonia at the rate of 1 cwt. per acre; the second paddock had only the phosphate. The grazing figures of the two paddocks were kept, as were also the milk returns, and results will be dealt with in conjunction with a number of similar experiments conducted by the Department of Agriculture.

A further trial with some of the concentrated manures now on the market was commenced during the year. A 10-acre paddock was divided into three equal parts, one being treated with superphosphate, one with Leunaphos (containing phosphate and nitrogen), and the other third with Nitrophoska (containing phosphate, potash, and nitrogen). Grazing data from each of these paddocks are being kept, and it is hoped that some valuable information will become available in due course.

Feeding of Concentrates to Dairy Cows.

With the object of obtaining information on the economic value of feeding to dairy cows small quantities of concentrates, in addition to the ordinary farm fodders (grass, roots, &c.), a test was commenced in the spring of 1927. The whole farm herd was fed with 2 lb. per day of a mixture of one-third each of crushed oats, bran, and linseed nuts, from the middle of August to the 10th September, and the milk weighed and tested for butterfat three times during the period.

The herd consisted of fifty-six cows, and on 10th September forty of what were considered the most suitable animals, giving due consideration to age, date of calving, and general condition, were selected and divided into two groups of twenty each, the same points being again taken into consideration, plus the milk weights and butterfat tests. When these groups were brought together it was found that Group A had given 324·23 lb. butterfat and Group B 322·82 lb. for the ten-day period ending 10th September. The general test was started as from 10th September; Group A (twenty cows) continued to receive 2 lb. of concentrates per day, and Group B (also twenty cows) no concentrates. The test was continued on these lines until 31st March, 1928, and the following summary gives the results:—

Table 1.

Month.	Feeding Group A.		Non-feeding Group B.		Increase of Group A over Group B.
	Butterfat for 10-day Periods.	Total for Month.	Butterfat for 10-day Periods.	Total for Month.	
	lb.	lb.	lb.	lb.	lb.
September	324·23		322·82		
	328·99		323·71		
	345·67		332·42		
		998·89		977·95	20·94
October	349·30		331·40		
	366·28		336·49		
	345·37		328·25		
		1,060·95		996·14	64·81
November	341·08		332·56		
	352·56		325·49		
	326·72		299·76		
		1,020·36		957·81	62·55
December	327·75		281·01		
	315·63		270·84		
	326·66		297·95		
		970·04		849·80	120·24
January	304·07		274·28		
	302·74		262·09		
	274·65		239·55		
		881·46		775·93	105·53
February	246·84		202·47		
	221·21		185·74		
	227·54		189·47		
		695·59		577·68	117·91
March	229·21		198·82		
	245·58		213·46		
	221·38		193·68		
		696·17		605·96	90·21
Total for seven months	..	6,323·46	..	5,741·27	582·19

The results may be summarized as follows:—

Feeding group	6,323·46 lb. butterfat.
Non-feeding group	5,741·27 lb.
Difference in favour of feeding group	582·19 lb.

	£ s. d.
Cost of concentrates, at 3d. per cow per day, for 210 days	52 10 0
582 lb. butterfat at 1s. 6d. per pound	43 13 3
Loss ..	£8 16 9

Average for feeding group, 236 days in milk	335·56 lb. butterfat.
Average for non-feeding group, 237·5 days	317·36 lb.
Average increase of feeding group	18·30 lb.

Particulars of the loss on concentrates are shown in the following table:—

Table 2.

Month.	Cost of Concentrates.	Value of Extra Butterfat.	Profit or Loss.
	£ s. d.	£ s. d.	£ s. d.
September	7 10 0	1 11 6	5 18 6 loss.
October	7 10 0	4 17 6	2 12 6 ,,
November	7 10 0	4 13 9	2 16 6 ,,
December	7 10 0	9 0 0	1 10 0 profit.
January	7 10 0	7 17 6	0 7 6 ,,
February	7 10 0	8 17 0	1 7 0 ,,
March	7 10 0	6 15 0	0 15 0 loss.

These figures show a loss from concentrate feeding for the three best production months—September, October, and November; a slight gain for December, January, and February, when the monthly totals of butterfat are going down; and a loss of 15s. for March, which month showed a slight increase over February. These results are for one season only, but to a great extent they bear out the data obtained in a similar test at the Waimate West Demonstration Farm in the preceding year.

The trial was repeated at Stratford in 1928–29, with the addition of a third group of cows. The whole herd was again put under test, and two main groups of sixteen cows in each and a third group of twelve cows were selected, the groups being kept the same as in the previous seasons as far as possible. The groups were made up of sound cows, the animals which were being carried through and those which had "slipped" being discarded. This accounts for the groups being smaller numerically than they were in the previous season. Calving-dates were given due consideration in the selection of the groups.

The butterfat-production per cow in the first period of ten days was as follows: Group A, 12·33 lb.; Group B, 12·34 lb.; Group C, 12·13 lb. The test commenced on 1st September. Group A was fed with concentrates at the rate of 2 lb. per day, made up of a mixture of one-third each crushed oats, bran, and linseed nuts. Group B received no concentrates at all, and Group C was fed in the same way as Group A till 21st October, or, roughly speaking, for the first seven

weeks of the season. Apart from the concentrate feeding, all groups had exactly the same treatment as regards paddocks supplementary feeding on hay and roots, &c. The trial was continued until 30th April, and the following summary gives the results of the two main groups :—

Table 3.

Month.	Feeding Group A.		Non-feeding Group B.		Increase or Decrease of Group A.
	Butterfat for 10-day Period.	Total for Month.	Butterfat for 10-day Period.	Total for Month.	
	lb.	lb.	lb.	lb.	
September ..	219·48		240·55		
	237·01		238·92		
	236·52		241·18		
		693·01		720·65	Decrease 27·64 lb.
October ..	257·24		284·34		
	258·19		266·53		
	269·38		259·72		
		784·81		810·59	Decrease 25·78 lb.
November ..	252·14		251·14		
	247·39		252·78		
	244·38		241·93		
		743·91		745·85	Decrease 1·94 lb.
December ...	225·87		244·32		
	223·33		229·03		
	219·06		216·67		
		668·26		670·02	Decrease 1·76 lb.
January ..	239·05		219·03		
	230·19		216·00		
	204·68		202·38		
		673·92		637·41	Increase 36·51 lb.
February ..	217·71		221·49		
	205·77		199·58		
	191·86		182·69		
		615·34		603·76	Increase 11·58 lb.
March ..	165·25		164·76		
	171·49		174·98		
	159·01		169·64		
		495·75		509·38	Decrease 13·63 lb.
April	140·04		155·71		
	148·37		150·78		
	134·41		134·44		
		422·82		440·93	Decrease 18·11 lb.
Totals, &c. ..	..	5,097·82	..	5,138·59	Net dec., 40·77 lb.

Summarized results are shown in the following figures :—

Feeding group A .. .. 5,097·82 lb. butterfat.
Non-feeding group B .. .. 5,138·59 lb.

Difference in favour of B .. .. .. 40·77 lb.

	£	s.	d.
Cost of concentrates, 16 cows, 242 days, at 3⅛d. per day	53	15	6
Plus loss of 40·77 lb. butterfat (decrease of fed group) at 1s. 6d. per pound	3	1	2
	£56	16	8

It is not suggested that this loss of £3 1s. 2d. worth of butterfat is the direct result of the concentrate feeding, but the main point is that there is no significant difference in favour of the fed group, let alone a difference that would cover the actual cost of the feeding.

On account of Group C being composed of only twelve cows, as against sixteen in Groups A and B, the comparison in this case is made per cow. The butterfat-production per cow in each of the three groups is as follows: Group A, 318·61 lb.; Group B, 321·16 lb.; Group C, 332·12 lb. The value of the butterfat produced per cow in the different groups is: Group A (fed whole season), £23 17s. 10d.; Group B (control), £24 1s. 8d.; Group C (fed seven weeks), £24 18s. 2d. In other words, the group fed for the whole season showed a decrease of 3s. 10d. worth of butterfat per cow, while the group fed for seven weeks showed an increase of 16s. 6d. worth. In addition, the cost of feeding per cow of Group A was £3 7s. 2d., making a loss of £3 11s. on this group; while the cost of feeding Group C was 14s. 2d. per cow, showing a profit of 2s. 4d. per cow in increased butterfat over cost of feeding.

As regards the results, the difference in the butterfat return per cow for any one group is not significant enough to show that any profit can be made from concentrate feeding, and indications over the two seasons' work point rather in the opposite direction. The results only strengthen the supposition that where cows come into profit in good condition, and are provided with *sufficient* good pasture and roots, the feeding of small quantities of concentrates is not directly profitable.

Another point worthy of consideration where concentrate feeding is being carried out is in connection with dairy-stock diseases, but as far as this farm is concerned the 1928–29 season's trial gave no indication that the feeding had any direct beneficial results, as an equal number of cows in each of the preceding season's groups calved prematurely and one in each group failed to hold to service at the beginning of that season. While this cannot be taken as conclusive by any means, it is an interesting observation.

General.

During the season under review the herd consisted of fifty-four cows, and the butterfat average, taken from factory returns, was 308 lb. per cow. Production was lower than during the preceding season, mainly owing to a smaller herd going through the shed on account of heavy sales of stock during the previous dry autumn, and partly due to the failure to come to profit of a few of the cows.

Two general field-days were held during the year, and these were well attended; in addition several district field-days took place. The farming public are continuing to take a keen interest in the farm and the various trials and experiments.

Alleged Honey-poisoning.—In connection with the alleged honey-poisoning cases which occurred at Morrinsville in March, 1928, arrangements were made by the Horticulture Division under which a test hive was placed in the locality. Honey taken from this hive at intervals during last season was submitted to examination at the Wallaceville Laboratory, but all the tests proved negative.

BUTTERFAT LOSSES IN BUTTERMILK.

INVESTIGATION IN AUCKLAND PROVINCE.

W. H. Udy, B.Sc., A.I.C., Dairy Research Laboratory, Hamilton, in the *New Zealand Journal of Science and Technology*.

Introduction.

In 1926 a report was drawn up by the writer on the butterfat losses in buttermilk over the 1924–25 season at a number of South Auckland dairy-factories, and though the methods of investigation were not wholly satisfactory it was indicated that very serious losses were occurring. The system adopted in order to check the amount of the loss at each factory was to obtain ten-day-period composite samples of buttermilk at a central laboratory for each of the butter-factories, and these were analysed for fat by a modified Rose Gottlieb method, while the total solids was determined and the percentage of fat calculated on a buttermilk containing 8·8 solids-not-fat.

It has to be remembered that after a cream comes into a butter-factory in New Zealand a considerable amount of water finds its way into the skim-milk portion by the time this latter appears as buttermilk, and it is thus necessary in any system for determining the fat losses to either measure the quantity of buttermilk produced and test same for fat, or else, by working on the solids-not-fat figure and estimating the amount of added water, to make allowance for the added water. Any test of fat alone is quite meaningless unless account is taken of this added water. To measure the amount of buttermilk daily is a somewhat difficult proposition, and it was therefore thought better to proceed on the second line of action—namely, to determine the solids-not-fat and to calculate from this the added water.

Following on the first season's work an attempt was made to institute a system whereby the work might be done at each factory and the daily losses obtained for the guidance of the factory-manager. In this work a daily proportioned composite sample of buttermilk was drawn and tested in the factory test-room. The fat was done by the butyl-alcohol modification of the Babcock test, details of which are given later in this report. The total solids were done by weighing 10 grammes of buttermilk into an aluminium beaker as used for butter-moisture determination, and the drying was done rapidly in a similar manner as is used for moisture determinations of butter. In experienced hands this method of determining total solids in buttermilk will give results with a maximum error of under 0·2 per cent., which was considered sufficiently accurate for the purpose.

Having determined the total solids and the fat in the buttermilk, the added water was determined from the following formula :—

$$\text{Added water} = [8{\cdot}8 - (\text{TS} - \text{F})]\frac{100}{8{\cdot}8}$$

where TS represents the total solids determined and F the fat test of the buttermilk. In this formula 8·8 is taken as the normal amount of solids-not-fat in buttermilk free from water added in the factory. The figure actually will vary a few points, but this will have but little effect on the loss figure, and was considered suitable for our purposes.

The fat in buttermilk free from added water was calculated from the following formula :—

$$F\ (w.f.) = \left\{\frac{8{\cdot}8}{TS - F}\right\} F$$

where F (w.f.) = fat in buttermilk free from added water ;
TS = total solids in buttermilk ;
F = fat test of buttermilk.

The losses of butterfat are best expressed as a percentage of the butterfat handled. If the quantity of buttermilk obtained were measured, this with the fat test would enable the total fat lost to be determined and expressed as a percentage of the fat received. Where the quantity of buttermilk is not measured, the quantity of buttermilk free from added water can be calculated from the weight of cream and the average test by the following formula :—

$$Bm. = W\left\{\frac{100 - 1{\cdot}12T}{100}\right\}$$

where Bm. = buttermilk free from added water ;
W = weight of cream ;
T = fat test of cream.

This formula is based on the fact that analyses of butter indicate that approximately 10 per cent. of its weight is buttermilk. From 100 lb. of cream, therefore, the quantity of buttermilk which goes to waste is 100 lb., less the fat and one-tenth of the weight of butter. Butter equals .1·2T.

From this calculated weight of buttermilk and its test the total fat lost is estimated, and expressed as a percentage of fat received.

This system of checking butterfat losses was carried on over one season, but again figures were found to be somewhat unreliable, mainly due to the fact that the method of determining total solids was not satisfactory under factory test-room conditions, and errors greater than anticipated were encountered. The additional season's work, however, supplied further knowledge of the great losses of butterfat occurring.

At the beginning of the 1928–29 season the present work was undertaken. It had for its objects—firstly, an investigation into the methods to be used for analysing and testing buttermilk for fat, and the institution of a system for making a daily check of the fat losses at the factory ; secondly, the actual losses occurring from day to day at fourteen different butter-factories operating throughout the Auckland Province were to be determined, using the butyl-alcohol modification of the Babcock test for testing for fat, and determining the solids-not-fat by the use of a Quevenne lactometer and the Richmond slide-rule.

The testing-work at the factories was checked by taking during each ten-day period one duplicate sample and forwarding to the central laboratory, where the fat was determined by the Werner Schmid method and the total solids determined gravimetrically. A series of cream-samples was also taken from each factory in order to obtain the solids-not-fat figure for use in determining the added water from the analytical figures on the buttermilk.

In addition to the above, the work was designed so that a study could be made of factors contributing to losses of fat in buttermilk.

Determining Losses occurring during 1928–29 Season at Different Factories.

The present report will be confined to the second portion of this work—namely, the determination of the losses actually occurring from day to day at fourteen different butter-factories in the Auckland Province.

Although the checking-up of losses at such a large number of factories at the one time is a difficult proposition, it was thought that a comparison of results obtained under so many different conditions would be an important means whereby causal factors might be traced. The actual establishment of the system whereby these losses might be efficiently determined was also considered an important function of the work.

Sampling of Buttermilk for Analyses.

The sampling of the buttermilk was carried out by the churn assistant with the use of a half-gallon dipper, which was marked off in five equal portions, representing approximately 1 lb. of buttermilk. With this dipper a proportional amount of buttermilk was drawn. The sample was taken half-way through the run-off, and was run into a covered can, which received samples from all churnings for the day. At the end of the day's churnings a well mixed sample was taken into the test-room, any butter granules were filtered off through buttercloth, and the sample then tested for fat and the lactometer reading and temperature taken.

Daily Testing of Buttermilk.

The fat test was carried out by the butyl-alcohol modification of the Babcock test. 6 in. test-bottles with 18-gramme bodies and necks, and graduated to 0·50 per cent. in 0·01 markings, were used. Details of the test are as follows:—

To the 0·5 per cent. Babcock bottle add as follows: 2 c.c. butyl alcohol, 9 c.c. milk, 9 c.c. sulphuric acid. Mix thoroughly, and whirl ten minutes in Babcock centrifuge. Add hot water to bottom of neck; whirl five minutes. Add hot water to neck; whirl three minutes. Read fat-column at 135–140° F., and double the reading (including the meniscus). It is best to use fairly strong acid—*i.e.*, not less than 1·83 specific gravity. The amount of acid can be varied to suit the strength. The right amount is being used when the curd is completely dissolved, and the fat-column is golden yellow or light amber in colour. If a dark streak or charring is showing at the bottom of the fat, too much or too strong acid is being used; if curd is showing, too weak or too little acid is being used. The speed of the machine should be raised above that used for ordinary testing by about 200 revolutions per minute. Care must be taken that test-bottles do not choke up at the neck, thus preventing the fat from rising into the column.

A blank determination should be tried occasionally—*i.e.*, put the test through using pure rain-water instead of buttermilk, and see if any fat is indicated. If any fat shows in the column on completion, something is wrong. The cleansing of the bottles and the purity of the acid and butyl alcohol must be investigated.

The fat test was entered daily on a report-sheet, together with the temperature and lactometer reading. Quevenne lactometers were used, reading from 0° to 40°. These were first tested against an N.P.L. standard. The lactometer reading was taken to an arbitrary but well-defined point approximating the top of the meniscus.

The weight of butter churned was also entered on the report-sheet. This was done because it is impossible to obtain figures showing weight of cream churned unless special equipment is provided for measuring up same. The butter figure serves sufficiently well for practical purposes in arriving at the weighted-average fat test in buttermilk over a period, since the average fat test of the cream varies but little from day to day.

The report-sheets were made up in ten-day periods—three periods commencing as near as possible on the 1st, 11th, and 21st of each month.

Calculation of the Percentage of Fat in Buttermilk free from added Water.

The great difficulty that exists in obtaining a system for checking up fat losses in buttermilk arises out of the fact that water is added to the cream in the factory either as rinse-water from cans and factory equipment or as break-water during the churning operation. This addition of water varies very considerably from one factory to another, and a simple fat test on a buttermilk is no indication as to what the losses are. In some cases no break-water whatever is added, while in others up to as much as 50 per cent. of the buttermilk has been found to be added water. The calculation of the fat losses is therefore dependent on a determination of the amount of this added water.

To do this, the total-solids figures were first worked up from the test-room figures by the use of the Richmond scale, using the formula $T = \cdot 25G + 1 \cdot 2F + \cdot 14$. The solids-not-fat figure was then calculated on the buttermilk free from fat. Thus if x = percentage fat in buttermilk and y = solids-not-fat, corrected solids-not-fat = $\frac{100\,y}{100 - x}$. This was necessary for comparison with the basic figure, which must be determined from cream as solids-not-fat and expressed in the same manner.

In order to determine the amount of added water in previous seasons' work the writer had fixed 8·8 as the basic solids-not-fat in the fat-free portion of a cream coming into a factory, and used the formula

$$\text{F (w.f.)} = \left\{ \frac{8 \cdot 8}{\text{TS} - \text{F}} \right\} \text{F}$$

for calculating the fat in buttermilk free from added water. In this work, however, an attempt was made to arrive at something more accurate, and with this in view a large number of daily composite cream-samples were taken at the different factories. Home-separated cream when it comes into a factory has already had water added to it in varying amounts by the supplier, and the solids-not-fat content of home-separated cream is therefore somewhat less than is the case with factory-separated cream. A knowledge of the class of the supply together with the analyses of the one-day composite cream-samples enabled a basic figure to be fixed for each factory. These ranged

from 8·6 to 9·0 per cent., and must be looked upon as approximations only. In any day's cream-supply the figure might easily be as much as 0·3 out; nevertheless in the ten-day-period averages these errors will disappear and the loss figure will be a substantially correct indication of the position.

Table 1 sets out the ten-day-period average fat content of buttermilks calculated on the water-free basis. Fourteen factories are represented for the twenty-four periods of October to May inclusive. The ten-day weighted-average figure is calculated, as already mentioned, on the assumption that a daily butter-make is proportional to its buttermilk output.

Table 1.—Percentage Butterfat in Buttermilk free from added Water.

Period		Butter-factory.													
		No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13	No. 14
1928.															
Oct.	1	..	..	0·82	..	0·83	1·01	..	..	0·77	..	0·90	..	1·11	1·00
	2	0·93	..	0·81	0·70	0·89	0·97	..	0·51	0·80	0·98	0·90	0·68	1·17	1·02
	3	0·87	0·91	0·88	0·87	0·86	0·96	..	0·53	0·72	1·00	0·95	0·63	1·05	1·10
Nov.	1	0·97	0·89	0·86	0·88	0·83	0·97	0·97	0·52	0·75	1·05	0·92	0·67	1·01	1·10
	2	0·99	0·95	0·89	0·72	0·79	0·87	0·89	0·56	0·64	0·77	..	0·65	0·95	1·14
	3	0·90	1·03	0·88	0·77	0·71	0·91	0·89	0·52	0·66	0·94	1·01	0·64	0·98	1·10
Dec.	1	0·85	1·04	0·89	0·76	0·77	0·97	0·95	0·52	0·66	0·88	0·97	0·68	1·01	1·10
	2	0·98	1·05	0·77	0·69	0·70	0·91	0·91	0·49	0·70	0·86	0·83	0·66	1·30	1·15
	3	0·87	1·09	0·81	0·83	0·74	0·96	0·94	0·48	0·76	0·92	0·96	0·69	1·16	1·16
1929.															
Jan.	1	0·93	1·13	0·93	0·84	0·74	0·89	0·98	0·53	0·74	1·00	0·89	0·75	1·17	1·11
	2	0·95	1·14	0·90	0·95	..	1·00	1·07	0·55	0·81	1·13	1·00	..	1·12	1·10
	3	0·74	0·98	0·82	0·90	0·75	1·04	1·06	0·55	0·70	1·06	1·00	0·71	1·20	1·15
Feb.	1	0·80	0·95	0·86	0·92	0·82	0·97	1·02	0·56	0·69	1·03	1·03	0·72	1·11	1·21
	2	0·94	0·86	0·95	0·87	0·86	1·05	1·09	0·58	0·72	1·05	1·00	0·73	1·10	1·20
	3	0·92	0·93	0·95	0·85	0·85	1·17	1·18	0·55	0·84	0·96	1·09	0·77	1·14	1·26
Mar.	1	0·90	1·16	0·97	0·94	0·85	1·03	1·12	0·55	0·80	1·10	1·02	0·79	1·13	1·35
	2	0·99	1·16	1·07	0·95	0·90	1·11	1·23	0·62	0·79	1·13	1·06	0·78	1·17	1·34
	3	1·10	1·18	1·10	1·04	0·75	1·22	1·17	0·68	0·95	1·07	1·09	0·87	1·28	1·34
April	1	0·96	1·13	1·10	0·90	0·90	1·11	1·10	0·65	0·84	1·13	1·06	0·93	1·29	1·22
	2	0·97	1·14	1·00	0·92	0·95	1·20	1·12	0·66	0·94	1·23	1·01	0·82	1·42	1·15
	3	1·07	1·18	0·99	1·00	1·00	1·19	1·20	0·74	0·85	1·17	1·00	0·85	1·36	1·10
May	1	0·96	1·18	1·07	0·85	0·98	1·08	1·24	0·72	0·99	1·11	0·97	..	1·41	1·21
	2	1·04	1·16	1·16	0·85	1·10	1·24	..	0·66	0·93	0·90	0·95	..	1·23	1·13
	3	1·03	1·15	0·99	0·91	1·21	1·10	1·12	0·69	0·92	0·91	1·03	..	1·27	1·20

In order to get a true knowledge of the losses of butterfat it is necessary to express these as a percentage of the butterfat handled. The fat in buttermilk free from added water figures do not give indication of any advantage that is gained through the use of high-testing cream, as is the practice in New Zealand factories. However, since the test from one factory to another varies but little, they do give a knowledge of the comparative losses.

Table 2 sets out the percentage butterfat losses at the fourteen factories month by month. These figures are calculated from the fat in buttermilk free from added water figures, and from the calculated quantity of this water-free buttermilk. The latter was calculated from the formula already mentioned, namely—

$$\text{Bm.} = \text{W} \frac{100 - 1{\cdot}12\text{T}}{100}$$

The total weight of butterfat received was obtained from the usual factory weights and tests of cream received.

TABLE 2.—PERCENTAGE OF FAT RECEIVED LOST IN BUTTERMILK.

Factory.	Oct.	Nov.	Dec.	Jan.	Feb.	March.	April.	Total, Oct.-April.
No. 1 ..	1·14	1·27	1·20	1·14	1·18	1·32	1·26	1·21
No. 2 ..	1·24	1·32	1·45	1·51	1·26	1·45	1·52	1·35
No. 3 ..	1·16	1·19	1·10	1·20	1·27	1·46	1·34	1·21
No. 4 ..	1·08	1·02	0·99	1·16	1·18	1·29	1·22	1·11
No. 5 ..	1·20	1·04	1·02	..	1·20	1·16	1·43	1·15
No. 6 ..	1·36	1·26	1·34	1·39	1·50	1·57	1·58	1·40
No. 7 ..	..	1·25	1·25	1·40	1·42	1·56	1·48	1·36
No. 8 ..	0·73	0·76	0·70	0·75	0·81	0·86	0·92	0·77
No. 9 ..	1·03	0·93	0·96	1·01	1·03	1·15	1·14	1·02
No. 10 ..	1·36	1·26	1·48	1·46	1·39	1·52	1·58	1·42
No. 11 ..	1·33	1·36	1·29	1·39	1·45	1·42	1·48	1·38
No. 12 ..	0·84	0·84	0·90	0·98	1·12	1·10	1·17	0·95
No. 13 ..	1·39	1·28	1·65	1·43	1·22	1·31	1·37	1·39
No. 14 ..	1·38	1·50	1·52	1·31	1·62	1·75	1·46	1·48

RESULTS OBTAINED.

The two tables presented give indication of the losses that are occurring at fourteen different butter-factories operating under different conditions of manufacture and of cream-supply. A comparison of the figures shows that wide variations of losses of butterfat in buttermilk are occurring. The difference between the highest and lowest loss figure is 0·71 per cent., and this on a factory handling 1,090 tons of butterfat represents a saving of 7·1 tons of butterfat, which, at 1s. 6d. per pound, would be valued at £1,209. The actual differences in the loss figures that are occurring in the industry to-day are therefore of considerable importance. The facts demonstrated by the above figures might conveniently be expressed by saying that some factories are adding to the cost of manufacture, by as much as £1 per ton, by excessive losses in buttermilk over and above what better-controlled factories are doing.

In concluding, I would remark that the butterfat losses in large factories are of such importance that it would well pay a factory management to install milk-meters for measuring the daily output of buttermilk as it is delivered, and automatically sample same for daily testing.

Stock slaughtered on Farms—The stock slaughtered for domestic consumption on farm holdings during the twelve months ended 31st January, 1929, was as follows: Sheep, 527,705; lambs, 47,865; bullocks, 1,770; cows, 3,828; calves, 2,077; pigs, 46,391.

SEASONAL NOTES.

THE FARM.

Autumn Sowing of Pastures.

ONE of the most important autumn considerations on the farm is that of pasture seed mixtures. The research of later years has considerably modified the work of deciding upon the constitution of mixtures suitable for use over much of New Zealand. Fortunately the tendency has been towards simplicity, brought about both by a reduction in the number of species commonly used and by a reduction in the number of seed mixtures it is deemed necessary to employ. The changed position may be summed up by saying that now the tendency is to modify soil-conditions by manuring, draining, &c., to suit the best pasture species, rather than to adapt pasture mixtures to the soil conditions as they exist on the farm. The extent to which this can be practised is subject to important limitations due to climatic and economic considerations, but it can be done to a greater extent than would at first sight seem to many to be possible.

The changed position arises mainly from a fuller realization of the importance that may be assigned to top-dressing as an aid in grassland farming. For many years the natural fertility of the soil has been a large factor in determining the contents of seed mixtures and the results obtained from the mixtures. To-day, now that the farmer often has the influence of top-dressing available, the ingredients of pasture seed mixtures are being determined not so much by the initial fertility of the soil as by the soil moisture-supply, the climate, and the top-dressing plans which are made. Further, apart from the place being played by top-dressing in seed-mixture considerations, weight requires to be given to the fact that a relatively simple seed mixture may suitably be used over a fairly wide range of soil. This is because the species in the mixture which are suited to the particular fertility conditions will become dominant, while other species included will play a valuable though subordinate role.

Permanent Pasture.—The position is possibly best made clear by citing a seed mixture for the establishment of permanent pasture recommended by Mr. E. Bruce Levy, Agrostologist, Department of Agriculture, for use on fairly good-quality ploughable land over wide areas in both the North and South Islands. The mixture is: True perennial rye-grass, 20 lb. to 25 lb.; New Zealand cocksfoot, 10 lb. to 15 lb.; crested dogstail, 3 lb.; timothy, 3 lb.; New Zealand white clover, 2 lb.; red clover, 3 lb.: total, 46 lb. (All amounts given here in this and other mixtures are per acre.) The larger amount of cocksfoot is to be used only when the smaller amount of rye-grass is used. The smaller amount of rye-grass is used mainly when the summer rainfall is below that suitable for permanence of rye-grass, as under Canterbury or certain similar conditions; and, again, when fertility is below that demanded by rye-grass and cannot economically be raised to rye-grass standard.

This mixture is recommended for use on country with a carrying-capacity which is, or can economically be made, at the rate of one cow to 2 or 3 acres or better; or at the rate of two to three ewes to the acre or better. Such a mixture, if used on land of the higher carrying-capacity mentioned, would result in a permanent pasture in which rye-grass and white clover would be dominant. If used on land of the lower carrying-capacity it would tend to result in a pasture in which cocksfoot, dogstail, and white clover would be dominant, unless, when soil moisture-supply was favourable, it proved profitable to top-dress to bring fertility up to the standard of rye-grass and white clover dominance.

The mixture detailed above may advantageously be modified under certain special conditions. The following are cases given by Mr. Levy: On land of naturally high fertility, where the permanence and good growth of rye-grass all the year is known to be assured, cocksfoot may be omitted, as its presence would add to the difficulties of management. Poa trivialis, at the rate of 2 lb. per acre, is a species which should be included on high-class country which is inclined to be damp in the winter. Meadow foxtail is a grass of first-class value on fertile swamps where the winter conditions are too wet for rye-grass to thrive, and 6 lb. should be included for such conditions. However, it is recommended in respect to such land that, instead of sowing foxtail, if it is at all possible the land be drained and made habitable for rye-grass. Strawberry clover at the rate of 1 lb. may be added for use on salty marshy conditions, or it may be substituted for white clover on saline soil which becomes wet because of tidal action. In parts north of a line drawn across the North Island through New Plymouth, Hamilton, and Gisborne, paspalum, at the rate of 6 lb. to 8 lb., can replace cocksfoot.

Over a wide range of conditions manuring at the rate of 2 cwt. to 3 cwt. per acre of high-class fertilizer at time of sowing-down will prove advantageous. During the past year a mixture of superphosphate and sulphate of ammonia has been found to give splendid results in this connection where the young grass tended to be slow in development because of late sowing or somewhat low fertility.

Temporary Pasture.—Autumn-sown temporary pastures of one to two years' duration are at times of considerable value, mainly because they can be sown (1) to yield green feed in winter or early spring; (2) to spell and build up the fertility of land which has been regularly under the plough; and (3) to clear land of weeds, such as blackberry, prior to the sowing of a permanent pasture. A popular suitable seed mixture for temporary pasture consists of Italian rye-grass, 25 lb., and red clover, 4 lb. to 6 lb.

Temporary pasture may be sown successfully in March where a rape, kale, or turnip crop has been fed off. Provided the land is reasonably clean, disking will serve to provide a soil layer sufficient to properly cover the seed. Italian rye-grass sown about March after producing good spring feed may later be shut up for a hay or a seed crop.

Short-rotation Pasture.—On arable farms where cereal and forage crops constitute a major consideration, and where it is not profitable to raise the fertility to a standard that would support permanently the mixture given above for the establishment of permanent pasture, then temporary pastures of two to three years' duration are often most advisable. These can be obtained by using the following mixture: Italian rye-grass, 10 lb.; perennial rye-grass, 10 lb.; red clover, 4 lb.; white clover, 2 lb.: total, 26 lb.

Bush-burn Sowings.—An important topical matter is the sowing to grass of bush-burn country. In respect to seed mixtures the two main matters are the sowing of the primary burn and of the secondary burn.

Primary burn mixture: For the sowing of the primary burn Mr. Levy recommends the following mixture: Cocksfoot, 8 lb.; crested dogstail, 3 lb.; Italian rye-grass, 5 lb.; true perennial rye-grass, 10 lb.; Poa pratensis, 1 lb.; brown-top, 1½ lb.; white clover, 2 lb.; Lotus major, 1 lb.; Danthonia pilosa, 3 lb.: total, 34½ lb.

The presence of Italian rye-grass may be disadvantageous on country that cannot be stocked early owing to lack of fencing, &c. If it is expected that it will not be possible to stock by the time the Italian begins to smother other species it will be better to put 15 lb. of perennial rye-grass in the mixture and omit the Italian altogether. Particularly

for the better type of hill country it is most advisable to use the better class of rye-grass—the true perennial. In the past too much of the temporary type has been used. New Zealand cocksfoot is the best for permanence, which is desired for hill-country work. Danish cocksfoot would serve under conditions of rank growth, which should become a thing of the past on pastures both on the hills and on the flat. Poa pratensis is valuable, more particularly for fertile country such as would carry a ewe and a half or more to the acre. Brown-top is essential for less fertile parts of the burn, especially peaty areas where such trees as kamahi, rewarewa, and hinau were prominent in the bush that was felled. New Zealand white-clover seed should always be used. Danthonia serves to take up the running, when other species disappear, on dry knobs and sunny faces—areas which are too poor for any of the other species included in the mixture. These areas always occur on bush burns. Danthonia comes into evidence where there is slow establishing and slow producing; if conditions are good enough it is kept suppressed and confined to the poor and sunny knobs. Canterbury Danthonia pilosa seed is more reliable from the purity and germination standpoint than that from any other districts. It is necessary to be careful to secure Lotus major seed which is reasonably pure and free from Lotus hispidus, which is not of much value for hill country and which is a common impurity in seed from certain districts—Auckland, for instance.

Secondary-burn mixture: For the sowing of secondary bush-burns Mr. Levy recommends the following: Rye-grass, 8 lb.; brown-top, 2 lb.; dogstail, 4 lb.; white clover, 1 lb.; Lotus major, 1 lb.; Danthonia pilosa, 3 lb.: total, 19 lb.

This mixture is suitable for typical bracken, hard fern, and manuka burns. Where fertility is higher, as on mahoe, wineberry, and fuchsia burns, also logging-up burns, the addition of 4 lb. to 6 lb. of cocksfoot to the mixture is quite justified. On secondary burns rye-grass is included primarily to attract stock during the first six to nine months. It is doubtful whether the expense of the true perennial rye-grass is justified on the harder, poorer country, but if rye-grass is expected to be permanent, and especially if top-dressing is to be practised, then true perennial should be used. Under very dry conditions, such as obtain on much of the typical East Coast country, it is very doubtful whether Lotus major is worth while in mixtures for secondary burns.

It is better not to sow secondary burns before the autumn rains can definitely be expected; generally for the North Island this is about the middle of March. Hence in burning secondary growth it is well to make the main burning as late as possible—at the end of February or the beginning of March.

In all secondary burns building up the fertility by top-dressing is highly beneficial in regard to establishment and subsequent covering by the pasture, and is also of great assistance in the control of reappearing secondary growth. Hence it is often advisable to top-dress in the autumn or early winter, as soon as the seed germinates, with superphosphate at the rate of 2 cwt. to 3 cwt. per acre.

General Points.—The results of recent work continue to emphasize the necessity for the use of true perennial rye-grass when permanence is desired. Hence, when available, certified seed should be used; if certified seed is not obtainable, efforts should be made to secure other seed of known permanent character.

The necessity for a fine, firm seed-bed is great, and if there is neglect in this respect unsatisfactory results may be expected.

Top-dressing at or about the time of sowing seed sometimes greatly assists in bringing about vigorous successful establishment.

In the case of young pastures, it is well to apply top-dressing early—in time to prevent the development of deterioration, rather than to have to apply fertilizer later on in an endeavour to build up pasture which has deteriorated.

It is well to remember that true Western Wolths rye-grass is essentially shorter-lived than Italian rye-grass, and as a consequence the yield for a year from Italian rye-grass is likely to be greater than from Western Wolths.

For the rapid production of feed, 1 bushel of oats or barley can at times be sown advantageously with temporary or short-rotation pasture mixtures.

The matter of rolling at seed-sowing time is a vexed one because of variation in conditions. One rule of some value is to roll under dry, fine conditions, and not to roll under wet conditions with frequent rain.

Management of Established Pastures.

In districts where a fair amount of rain usually falls in March topping of the pastures with the mower is advisable during March to remove patches of long, rank, or matured growth. The removal of such patches facilitates the development of a valuable, even, fresh growth consequent on the autumn rains.

A further aid to the development of such growth consists in vigorous harrowing, which may effectively be carried out during March or thereabouts. Harrowing at this stage is specially necessary and valuable because of the droppings which accumulate during the dry period, when usually it is inadvisable to harrow pastures. Much the better distribution of droppings is effected by harrowing up and down a paddock in one direction and then across the paddock at right angles. At this season harrowing of pastures commonly errs in not being severe enough.

The advisability of applying phosphates to grassland in March or thereabouts has been stressed and explained previously in these monthly notes.

Red clover spring-sown with cereals will benefit greatly in the autumn, when rains are assured, by a dressing of superphosphate.

Forage Crops.

Feeding should be planned so as to utilize maize, millet, and sorghum crops before the middle of April, so that danger of frost damage may be avoided. Any portion of these crops not required for autumn feeding should be made into ensilage, provided there is at least 25 tons of material available for this purpose. When less material is available millet may be made into hay, but with this crop, provided there is the required bulk to handle, ensilage is preferable to hay, partly because of the difficulty of drying safely the coarse material in haying. Even though there may be somewhat heavy wastage with ensilage, or difficulty with hay, it is better to make one or the other rather than to leave the crops standing until they are frosted and become a total loss.

Land having grown cereal or forage crops, such as oats, wheat, maize, millet, or soft turnips, should be ploughed immediately the crops are removed. If the land is too hard for satisfactory skim-ploughings, cultivation with the disks set with plenty of cut may pay handsomely.

Crops which often may be sown with advantage during March for the provision of winter and spring forage include the following: Algerian oats, about 2½ bushels of seed per acre; Algerian oats, 1½ bushels, and Western Wolths rye-grass, 1 bushel; black skinless barley, 2½ bushels. With all of these a dressing of 1 cwt. to 2 cwt. of superphosphate can usually be applied with profit.

The preparatory cultivation for autumn-sown crops should aim not so much to produce a finely pulverized layer of surface soil as fine soil below

the surface. Provided this latter is obtained small clods on the surface are not a disadvantage, as eventually they will be broken up by natural weathering processes.

Lucerne.

During March a cut for hay or green feed can often be obtained from lucerne fields. After such a cut, if the lucerne is infested with weeds and the conditions are dry, it may be advantageous to run over it with tine harrows. However, it is probable that on the whole more harm than good is done throughout New Zealand by surface tillage of lucerne, for often any tillage sufficiently drastic to remove persistent weeds may also be depended upon to destroy a number of the lucerne-plants. The number destroyed in any one season may not be very noticeable, but when destruction of lucerne-plants by cultivation is continued over a number of seasons quite noticeable thinning of the stand results.

When weed infestation definitely makes cultivation advisable, implements with narrow-pointed tines are preferable, in order to minimize injury to the lucerne.

Generally, mowing the crop at the proper stages, liberal manuring, and refraining from grazing are preferable to surface tillage as means of combating possible weed invasion. However, under certain conditions of friable soil, good results have been obtained by March tillage with harrows, followed by a light seeding of Italian rye-grass or Algerian oats. In this case it is necessary to cut the resultant growth early in the spring for green feed or ensilage; if this is not done harmful smothering of the lucerne results.

—R. P. Connell, M.A., Fields Division, Palmerston North.

THE ORCHARD.

Spraying Operations.

Periods of moist, humid conditions such as are often experienced will occasion much anxiety to orchardists as the fruit approaches maturity. Given suitable atmospheric conditions, the appearance of ripe-rot and black-spot may be so sudden and the spread so rapid that it is wise to anticipate them and spray accordingly. The arsenate-of-lead sprays should be continued on the later-ripening varieties of apples and pears for codlin-moth, and powdery mildew will necessitate another precipitated sulphur spray.

Red mite and mealy bug will often become prevalent on apples as the season progresses, and as neither of these pests is permissable in export or local market fruit their control is imperative. The presence of mite is readily detected by the washed-out appearance of the trees, and the mites will be found mostly on the underside of the leaves and on the fruit, where they deposit their tiny, roundish, red eggs in the calyx cavity. Mealy bug is not so readily detected, as the eggs are laid in the fine web-like mass in the stem cavity. The value of effective early spraying is appreciated when these pests make their appearance, necessitating cessation of packing or greater vigilance in grading. Special summer oils have been found effective for this purpose, as also has Black Leaf and kerosene emulsion, but the tendency of oil to promote russetting, and of Black Leaf to leave unsightly blotches, makes careful application necessary. Ordinary spraying-oil may be used at not stronger than 1–100, thoroughly wetting the undersides of the leaves and the fruit. The addition of about 1 lb. of soap to each 25 gallons of water, by breaking up the oil globules, increases the spread and adhesiveness and reduces the tendency to spotting.

Fireblight.

In affected districts fireblight should receive constant attention. Infected portions are liable to be missed during the dormant pruning, and the work is expedited if done while the foliage is present. Large trees, whose limbs do not receive the individual attention that is given to small trees, are liable to have diseased portions overlooked during the dormant period, and from these sources fresh infection can be disseminated in the spring, and the value of the previous season's work is nullified.

Pruning.

When the growth is well advanced and while fruit is still on the trees is a good time to make a general inspection to note the results of previous season's pruning and decide on any variations or alterations in the methods adopted. The variation in fruiting-habit in different varieties is so great that an intimate knowledge of each variety's peculiarities is essential if maximum results are to be obtained. Observation as to what type of wood the best fruit is produced on, and how the tree has responded to pruning, will help to correct past errors and prevent a great deal of anxiety on the part of those which whom pruning is not a business. The desirability or otherwise of removing limbs from the centre of the tree can be decided best while the fruit is in position and indicating by its colour whether conditions are to its liking. Crowded centres are not desirable, but what may appear crowded in the dormant season is often sufficiently open when the weight of fruit bears each limb outwards, and a little attention then may prevent sacrificing valuable fruiting-wood at the dormant pruning. Pruning is performed to assist and direct nature, and to co-operate fully it is necessary to know just how her energies are directed.

Destruction of Diseased Fruit.

In the rush of picking and packing, the destruction of diseased fruit is sometimes delayed until a favourable opportunity presents itself. Where codlin-moth-infected fruit is present the delay may be sufficient to allow the grub time to migrate and establish itself in winter quarters. The difficulty in controlling codlin-moth in the vicinity of packing-sheds is undoubtedly often due to this cause, and in the interests of next season's crop no effort should be spared in dealing with these potential sources of future trouble and expense.

Cultivation and Cover-cropping.

Weed-suppression has been difficult so far this season, due to the moist conditions prevailing, and where cover-crops are not being used a heavy crop of seedling weeds may be expected. Cultivation should therefore be continued as long as circumstances will permit. Sowing with rye-grass can be proceeded with during suitable weather conditions. Sowing during normal February weather is often unsatisfactory, and to get the longest possible growing-season seed can be sown early in March.

Propping and Tying.

Props should be examined occasionally, and adjusted if necessary to ease the strain on the heavily laden limbs, and extra ties can be put in for further support. Apart from the damage to the trees, splits and fractures provide shelter for codlin-moth and points of entry for fungoids which may cause further loss. In exposed positions reworked trees should be staked to protect the grafts against winds. Budding should be pushed on and completed before the sap-flow ceases.

The tendency in the Delicious apple to produce fruit with open cores should be borne in mind when picking commences. These are subject to infection by fungoids, which produce the condition known as mouldy core

and often comprise a large proportion of the first fruit to ripen. Though they may be satisfactory for immediate consumption their keeping-qualities are impaired, and they should not be used for export or storage purposes.

Citrus-culture.

Cultivation will be the dominant work for the coming month in this section. The abundant rainfall has stimulated growth to a greater extent than usual, and it will be possible to replace more of the weak or exhausted wood with fresh young growth. Some attention should be devoted to thinning superfluous shoots before they harden, and to shortening any growths which appear likely to extend unduly.

Autumn manuring will be governed by the condition of the trees. The application of quick-acting nitrogenous manures to trees already developing a large amount of young growth will tend to keep the wood soft and increase the liability to frost injury. Citrus derive more benefit from bulky nitrogenous manures than from the more easily applied chemical product; therefore consideration should be given to sowing a crop for ploughing in. Late February and early March is the best time for sowing, and preference should be given to a leguminous crop. For this purpose lupins, peas, or clovers will provide a good bulk of vegetable matter and, in addition, an appreciable amount of nitrogen. Sowing should not be unduly delayed, for the maximum amount of growth is desired, and it will be necessary to plough the material in early in the season in order that it may decompose before the trees commence their spring growth.

Unfruitful trees or trees of poor type may be top-worked or budded over to more profitable kinds as soon as suitable bud-wood can be obtained. Shield budding into reasonably fresh bark on the main stems is generally satisfactory, and the limbs in which the buds are inserted may be shortened somewhat to check the sap-flow. In selecting buds it is important that wood should be taken from trees of good habit that produce a desirable type of fruit. Strong-growing fleshy shoots and trees prone to developing excessive wood should be avoided, as these characteristics will be perpetuated in the new tree to the detriment of fruit-production. Short twigs on which fruit has been produced will provide the best bud-wood, which for satisfactory working should be round and free from thorns, with good plump buds. Triangular or flanged wood is not suitable, inasmuch as a sufficient width of bark cannot be obtained, and it is almost impossible to remove the surplus wood without damaging the eye. In budding seedling stocks it is important that the bud be inserted at least 9 in. above the ground-level to ensure that there will ultimately be a sufficient length of stock to protect the more susceptible variety against infection by soil-inhabiting fungi such as collar-rot.

—G. H. McIndoe, Orchard Instructor, Gisborne.

POULTRY-KEEPING.

Care of the Maturing Pullets.

On all premises where the early-hatched pullets are approaching the point of laying there should be no delay in placing the birds into their permanent winter quarters. This is now of paramount importance, for any change when the young bird is about to commence laying is apt to cause an early moult, and consequently a loss of autumn and winter eggs. An untimely moult will also be brought about if the ration provided is suddenly changed, and it must be borne in mind that the management of the pullet from which winter eggs are expected must be uniform in every direction. For this reason the sooner all the well-developed pullets are placed in their future

permanent quarters, and become accustomed to a regular diet, the less risk will there be of their moulting with the adult fowls and ceasing to lay when better prices for fresh eggs prevail.

Where the birds are well developed and nearing the laying-point it is a wise course to include in the ration by degrees some forcing diet such as meat or meat-meal; but the poultryman should on no account let the increasing price of eggs tempt him to unduly force the eggs until the birds are well settled down to their business. This should be particularly guarded against where a rich ingredient is included in a mash mixture. The best course to adopt is to provide the forcing-material separately, so that each bird may take what it requires and no more. In this way the bird will balance its own ration better than one can do it for her, for usually the ingredient that she likes is what she needs for producing a maximum egg-yield. Where a bird is forced to eat in a mash an excess of any forcing-material in order to secure a meal ovarian troubles such as protrusion of the oviduct will result, as well as the production of shell-less and double-yolked eggs.

Culling.

March may be regarded as the best month of the year for culling out unprofitable hens. In ordinary times efficient culling is one of the chief essentials if the business of poultry-keeping is to be made really profitable. The prevailing high cost of foodstuffs, however, in combination with the low price of eggs, makes this important work really essential, and if not properly carried out it may easily mean the difference between showing a profit and a loss.

The reason for stating that during March is the best time for culling a flock of hens is that at this period of the year—towards the termination of the laying-season—certain signs manifest themselves in individual birds as indicative of their laying-capacity. These signs are not only a good guide as to whether a bird is in a laying condition or not, but they also indicate to a great extent whether she has produced heavily during the past laying-season, and, further, whether or not she is likely to prove a good layer during the following season.

The experienced person who has a natural eye for form can quickly observe the change that takes place in the appearance of individual birds. This faculty of discriminating between the good and the poor hen, however, is one which may be developed by observation and study, and, better still, by first being given a practical demonstration by a person of experience. Once this qualification is acquired its value to the poultry-keeper cannot be overestimated. It enables him not only to eliminate poor producers from his flock, but also to select the best specimens for the all-important work of reproduction. These guides can be made use of only previous to the time of moulting, as no single characteristic of a bird can be judged with accuracy once the moulting process has begun.

There should therefore be no delay in carrying out a thorough culling campaign. Generally speaking, a safe principle to be guided by in culling is to eliminate all birds showing weakness in constitution, for no matter how well a bird has laid or how good the type she must necessarily prove disappointing as a layer, and to a greater degree as a breeder, once her vigour has become impaired. Obviously for a bird to continue heavy egg-laying (which is an artificially produced condition and causes a severe tax on the reproductive organs) health and vigour must stand foremost as compared with pedigree of performance, desirable type, or indeed anything else. A bird may prove to be a first-class egg-layer, but if in this effort her vigour has been weakened she should be rejected as a breeder, and it will seldom pay to keep her for any other purpose.

The period of moulting gives a good guide to the constitutional vigour and laying-capacity possessed. It is the long-season layer, the bird that

lays well in other than the natural laying-season (spring and summer)—that is desired and is the most profitable to keep. To do this a bird must necessarily be a late moulter, as the laying-season usually ends when the moulting-period begins. Therefore the birds that show evidence of being early moulters should be culled out and the late moulters retained for laying and breeding purposes. It must be remembered that this test only applies when the birds have been hatched at about the same time, and have been fed and managed under similar local conditions. For example, when first- and second-season layers are running together it will usually be found that the former will moult first, so that some allowance must be made for this. Especially is this so where the older birds have been selected as late moulters in the previous season. An early moult may also be caused by broodiness and by allowing a bird to sit on the nest for weeks at a time. A sudden change of food or quarters is also apt to have a similar effect at this period of the year. No rule is capable of universal application, however, and exceptions must be allowed for in applying the moulting test in the work of culling.

Apart from early moulting there are other signs suggestive of poor laying-capacity. These include an overfat condition, loose feathering, dull sunken eye, an inactive appearance, and poor development in the abdominal region. In the case of breeds with yellow legs it will generally be found at this season of the year that those birds which have lost the deep-yellow colour—the legs having become more or less white and bleached-looking—are the best layers, and the strongest birds in the flock, whereas those with legs of a rich yellow are the drones. It must be noted that this sign only applies towards the end of a bird's productive season, for after it has moulted the legs will soon regain their yellow appearance. The fact that the legs of the good layers become more or less bleached as compared with those of the poor layer is no doubt due to the yellow fat being drawn from them to supply the egg-yolk with its yellow pigment. Obviously the greater the layer the greater will be the tax on the fat content of the legs, and consequently the more bleached the legs will become. What applies in the case of the legs does so in like degree to the body-skin, particularly about the vent, and also to the beak. It may be mentioned that hens running on a grass range do not usually bleach out in the legs to the same extent as those kept in confinement. As is the case with early moulting, leg-colour is not always an indication of the conclusion of the individual fowl's normal laying period, and here again local conditions must be taken into account in applying the test.

In addition to being a late moulter, the high-type layer will usually present the following signs indicating laying-capacity and constitutional vigour: tight feathering, bright prominent eyes, clean face (often the head being devoid of feathers, a sign seldom or never found in a low egg-producer), deep abdominal development with fine texture of skin, well-developed crop, an active businesslike appearance, a more or less lean condition, and a worn-out, unkempt, rough-and-ready plumage. The reason for this is obvious, in that a hen could not be expected to lay on fat while producing a maximum egg-yield.

Summarizing the foregoing points, the birds that should be culled are those that show signs of moulting; those with a well-kept plumage, and which are above the normal weight of their breed; those with hard development in the abdominal region; and those with signs indicating a weak constitution, such as a dull sunken appearance of the eyes, heavy well-feathered eyebrows, bright-yellow legs, loose feathering, and sluggish appearance.

Selection of Breeding-hens.

It should not be taken for granted that because the weak types have been eliminated from the flock and only useful birds remain on the plant all of the latter are suitable for the breeding-pen. A bird may show

abundant evidence of possessing productive power, but something more is required. Obviously, if everything is sacrificed to egg-yield the other important points in the make-up of a good breeding specimen will suffer as a consequence.

Combined with the desired constitutional points and features pointing to laying-capacity, due consideration must be given to breed characteristics. If a uniform heavy-producing flock is to be built up and maintained, an ideal type, in addition to productive capacity, must be aimed at. It should always be borne in mind that the best layer is not necessarily the best breeder. Always avoid selecting for the breeding-pen undersized specimens of the breed, even although such birds have proved themselves to be good layers. They may succeed in a laying test, or even break records, but it is seldom or never that they will produce desirable progeny. It is always a good plan to choose for the breeding-pen a hen slightly larger than that desired in a laying flock. If this golden rule was practised more by the majority of our poultry-breeders, instead of making egg-yielding power the one and only consideration when selecting their breeding specimens, we would hear less about exporting $1\frac{3}{4}$ oz. eggs to the overseas market from those concerned in the export trade. If any argument is required to prove the fallacy of breeding from undersized specimens of their breed and producers of small eggs, then it is surely contained in the fact that there was a difference of 9s. per case of 30 dozen realized on eggs recently exported to London, and which weighed 17 lb. and 14 lb. respectively.

The novice who is really anxious to build up a high-standard flock of layers will be well advised to secure a copy of the "New Zealand Utility-poultry Standards," obtainable from the Department of Agriculture at a cost of 3s., post free. This contains plates illustrating the types that should be aimed at when mating stock, together with desired weight clauses and general standard requirements.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Final Extracting for Main Honey-flow.

FEBRUARY will probably see the end of the main honey-flow in most districts, and beekeepers will be wise to remove the last of the honey before the colder nights arrive. Once the honey in the hives has been allowed to become thoroughly chilled there is little prospect of its becoming warmed again when uncertain weather sets in. Wherever inclined to be thick the honey will be found exceedingly difficult to extract unless it is warm, and the beekeeper who delays too long will find that he will have to return to the hives combs almost as heavy as when they were removed. Thin honey extracts best when it is warm, but it is imperative that thick honey be not allowed to cool before extracting.

Condition of the Brood-chamber.

One of the principal matters to be attended to when the last of the honey is being removed is the condition of the brood-chamber. Many prolific queens keep the brood-chamber so full of brood throughout the season that the bees have very little room to store honey in it. Consequently if all the honey in the supers is removed such colonies stand a chance of being starved out before the end of the winter. These colonies should not be reduced to less than two stories, and on no account should their stores be less than 30 lb. to 40 lb. It must be borne in mind that all the brood

in the hive will hatch and must be fed, and that in addition the queen will continue laying for some months to come, while in some districts breeding may continue throughout the winter. To ensure the colony coming out strong in the spring it must be left with ample stores to carry it through the months of dearth. Unless there is ample evidence of an abundant autumn flow the beekeeper would be wise to leave his hives oversupplied rather than undersupplied.

Use of Bee-escapes.

For the comb-honey producer the Porter bee-escape is an invaluable aid in the removal of his crop. Removal of comb-honey by the ordinary method of brushing, &c., is apt to result in the piercing of many cell-cappings, with constant leakage; but by the use of this simple little appliance, fitted in a board the size of a super, comb-honey can be removed without any disturbance of the colony. The super or supers should be prized up from the brood-chamber, two or three puffs of smoke driven into the hive, and the board gently slipped into place with the round hole of the escape uppermost. If this is done in the afternoon, by morning the super will be empty of bees.

Prevention of Robbing.

The taking of the last of the honey is the time when the beekeeper must display endless caution to prevent robbing. A bad attack of autumn robbing is—next to disease—about the worst thing a beekeeper can experience. Before starting the day's work he should have all appliances handy, have formed a plan of how the work is to be carried out, and should, if satisfactory, adhere to that plan throughout the day. A light barrow fitted with a tray to catch honey-drips, and two or three cloths of a size to cover the whole of a super are some of the things which will obviate much trouble. As the combs are removed from the supers they should be brushed and shaken as free of bees as possible, placed in an empty super on the barrow, and covered with a damp cloth. Close every hive as soon as it is finished with, and remove the combs to the honey-house, which should be bee-proof. At the close of the day the wet combs should be returned to the hives as expeditiously as possible, and by morning the apiary will be found to be in its normal condition. No pieces of wax, spilt honey, or anything likely to attract the attention of the bees should be left uncovered.

If the bees show a tendency to pounce on any particular hive the entrance should be contracted considerably and wet grass piled in front of the hive. If working in one portion of the apiary should cause robber bees to become too attentive it is advisable to shift the scene of operations to another part. It must be borne in mind that autumn robbing once commenced is hard to check, also that it is usually brought about by careless manipulation of the hives.

Weak Colonies.

As far as possible, weak hives should not be tolerated during the winter months. During the warm days these stocks rarely escape the attention of robber bees, and are easily molested. Once they are attacked it is exceedingly hard to save them, and despite the efforts of the beekeeper they eventually get robbed out. It is usually the presence of weak hives in the apiary that starts autumn and winter robbing, and it is by far the best plan to unite them with stronger colonies in the apiary and avoid the risk of creating a disturbance among the bees when normal winter conditions should prevail. If weak colonies are not detected until late in the season a good plan to follow when uniting them is to put the weak hive on top of a strong one, placing a piece of newspaper between the two hive-bodies. In the course of a few days the bees in the weaker hive will eat their way through the paper and unite peaceably with the bees in the stronger hive

The surplus combs may subsequently be removed, and the hive made snug for wintering. If weather conditions permit, it is advantageous to destroy the queen in the weaker hive prior to uniting.

Preparations for Winter.

As soon as the last of the honey is removed the beekeeper should see that the colonies are in good order for wintering. The first matter for attention is that of stores, which, as already indicated, should be abundant; the second that of the queen's condition. After these two important matters are settled the beekeeper should satisfy himself that his hives are water-tight and draught-proof, also that his apiary is well provided with shelter in the form of good hedges or other windbreaks.

With regard to the queen, autumn is the time when strict attention should be paid to weak and failing queens. None but the best queens should be allowed to go into winter quarters. Poor queens should be destroyed, and either superseded by young and vigorous ones or their colonies united with those of the better queens before the winter sets in. No queen should be tolerated which cannot provide the colony with an abundant supply of young workers before the cold weather arrives. It is quite certain that the queen which goes back in the autumn will be in worse case after the winter, and will not produce enough workers to provide a surplus in the following season, even if she does not fail entirely before the spring or develop into a drone-layer as soon as brood-rearing commences.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

The Tobacco Crop.

As the season advances, and lower temperatures with increased humidity are experienced, the management of the leaf that is being air-cured must be adapted to the changing circumstances. During foggy nights and wet days the sheds should be closed, except for a minimum ventilation at the top, and smouldering fires of dry hardwood started in trenches in the ground. With a rising barometer and dry winds the ventilation must be increased again. It is only by careful regulation of this kind that suitable conditions can be maintained and curing brought to a conclusion without delay. Until the crop is bulked down under good conditions it will demand constant attention. This will be best given if the curing management is the responsibility of one individual.

When the leaf is cured to good colour and thoroughly dried out it should be conditioned and bulked down at once. Perhaps no operation is generally performed in so unsatisfactory a manner as this conditioning, and heavy losses are incurred annually by handling leaf in a more or less dry state, by which method it is torn and damaged and waste accumulates.

Dry leaf, in a cool state, readily absorbs atmospheric moisture, and by doing so its texture changes from that which is comparable to the thinnest and most delicate egg-shell, and is as easily crushed, to that of a piece of silk which may be squeezed in the hand without injury and resumes its natural fold as soon as it is released. In this latter state only can it be safely handled for grading, tying into hands, and bulking down. If this leaf is tested it will be found to contain about 12 per cent. of moisture; more than this quantity is apt to damage the leaf after bulking by causing a dangerous temperature, spoiling colours, and even destroying the texture. For this reason the point demands the nicest care to properly

condition not merely a portion but the whole quantity of leaf that is about to be graded and bulked. The requisite condition may be obtained alternatively by admitting steam into the building, by placing the leaf in a cellar overnight, by opening ventilators and admitting air in a humid state, or by wetting the floors. As soon as the requisite condition is obtained the leaf should be stripped from the stalks, graded, tied into hands, and bulked down.

Commercial grading of tobacco-leaf requires demonstrating to be properly understood, but the chief points are texture and colour. Leaves of fine texture and heavy body are kept separate. In each of these classes the colours lemon, yellow, orange, red, and mottled are separated again, and tied in hands of fifteen to twenty leaves of the same colour. A well-lit apartment is required for this work.

The operation of tying leaves together into hands is often done in a careless manner, and values are often depreciated on this account, as such tying is usually an indication that the leaf generally has been given indifferent treatment. The binder should have the bright side of the leaf outermost; the ends of the stems should be even. Commence binding with the tip of the binder leaf, carry the bandage for a short distance along the stems, and bring the butt of the binder stem firmly through between the middle of the leaves forming the hand. If the stems of the leaves being tied are coarse and long they should be placed together and shortened by cutting before being bound.

As before stated, a room for bulking down should be thoroughly dry, clean, warm, and not subject to sudden changes of temperature. Specially should the floor be dry, close, and well up off the ground. If there is any doubt on this point a platform 1 ft. or so high should be made on which to build the bulk. Make the stacks about 4 ft. wide, placing the hands with the butts towards the outside, and the tips of the leaves slightly overlapping. Build up the stack with straight sides to a height of about 4 ft. (when compressed), and place a few boards on top with a moderate weight to compress the stack. For a week or two it should be examined occasionally to see it does not heat unduly. If the temperature rises over 80° F. the stack should be taken down, aired, and rebuilt. To prevent the leaf drying out or the light spoiling the colour the bulk should be covered with canvas or a waterproof material. Small quantities may be bulked down in a clean packing-case of a suitable size.

Tomatoes and Small Fruits.

The disease of tomato-plants caused by the fungus *Septoria lycopersici* has been prevalent to some extent this season. The trouble is commonly known as tomato leaf-spot, and where the crop is in poor condition its appearance is serious; otherwise a few applications of a good bordeaux mixture at rather short intervals will go a long way towards holding the disease in check while the crop is maturing.

A disease of small fruits that has been rather common is strawberry brown-rot. This disease, the Department's Mycologist informs us, is caused by a *Botrytis*, probably *B. cinerea*. The spores are omnipresent, and specially destructive in warm, cloudy weather, wet seasons, and badly drained land, also when planted close in a sheltered place. In localities where wet conditions are common effective ditching and careful spacing should be observed. Also, in spite of all the advantages claimed for shelter-belts, it is to be remembered that high trees around small areas in such localities are entirely unsuitable.

In the preparation of land for planting small fruits it is well to remember the crop depends very largely on the quality and amount of the preparation, especially for plants that remain on the land for a few years. To plough heavy land when it is too wet, and especially when its humus content is

low, is a very serious injury. Land of that class requires every consideration, to an extent that a grower used to light land is unlikely to appreciate. Deep cultivation is almost always an advantage. Not that the subsoil should be turned up to the top—that has been repeatedly shown to be a serious disadvantage—but a subsoiling method that breaks up the subsoil without bringing it to the top improves drainage and deepens fertility. Land of this class is also slower in absorbing surface water, and a well-thought-out scheme of ditching will confer great benefit in improving the conditions for cropping. From these remarks it will be seen that the work of preparation is not to be deferred and performed hurriedly at the last minute—that is, if good results are to be expected.

The Market-garden.

In northern districts, where it is the practice to sow the onion crop in the autumn for planting out in early spring, the seed may be sown now on a piece of land that is well drained, clean, not too rich, and well firmed; sowing should be thin. In the warmer districts it is not too late to sow seed-beds for a crop of the valuable spring cabbage, for planting out in the month of May.

As soon as a crop is harvested sow down the land in a cover-crop if it is not required for another purpose immediately. Remember this is one of the best and cheapest manures; in fact, in the absence of stable manure nothing else will give the same results.

Clean the young winter crops by hoeing in fine weather, and commence blanching the celery crop as it approaches maturity. Before doing this supply such water and manures as may be required.

The *Sclerotinia* fungi have been troublesome in a number of garden crops during the spring. The rather varied phenomena it produces in its victims is very striking. In a crop of spring lettuce it caused a soft rot of the roots; in a crop of radishes the effect was to contract and distort the edible root; while in the tomato crop its most familiar aspect is that of a canker just above the soil on the main stem. Such diseases as this compel one to weigh the respective merits of soil-sterilization and rotational cropping.

The Home Garden.

New lawns sown down at the present season run fewer risks of failure or delayed development than at any other period. This statement applies with little modification to the whole of the month of March. Suggestions for sowing lawns given last month should be noted. Carefully consider the matter of grades and levels before sowing. Nothing gives a garden a good appearance so much as well-chosen grades and a smooth surface on the lawns.

Carefully fork over the new shrubbery and herbaceous borders to clean them of twitch and all bad weeds. Work in such manures as may be necessary, and otherwise complete the preparation for planting trees and shrubs in the month of May.

—*W. C. Hyde, Horticulturist, Wellington.*

Standard Mark for Ryeland Sheep Society.—The Director-General, Department of Agriculture, notified in the *Gazette* of 23rd January that, in terms of section 3 of the Stock Amendment Act, 1927, and of the Standard Marks Stock Regulations, 1929, he had registered in the name of the Ryeland Sheep Society of New Zealand the brand or mark "R.N.Z." as a standard mark to be placed, by means of tattoo with Indian ink, on the right ear of stock which, in the opinion of the society, is of a standard of merit fixed by it.

WEATHER RECORDS: JANUARY, 1930.

Dominion Meteorological Office.

GENERAL NOTES.

JANUARY was a most unseasonable month. Unsettled weather prevailed with only a few short breaks. Cloudiness and the number of wet days were much above the average, while sunshine was considerably below it. Temperatures fell below the normal for January by an unusually large amount. Rainfall was almost everywhere in large excess. The only exceptions to this rule were in parts of North Auckland, the Bay of Plenty, and Southland. The month was, in fact, the wettest January since that of 1923, which was the wettest so far recorded. At Auckland, Timaru, Geraldine, and a few other places, record falls for January were experienced.

Though weather of the westerly type has again been less predominant than in ordinary years, the two spells experienced were quite sufficiently vigorous samples. The first occurred during the first week of the month. The principal depression of this series was a deep V depression which crossed New Zealand on the 4th. On that day there were widespread northerly gales. Very heavy and general rain fell on the 3rd and 4th. In the Thames Valley there was some flooding, and the Mangamahoe Dam in Taranaki was damaged by a cloudburst. On the 5th, though there was less rain, there were some severe hailstorms in Canterbury, Marlborough, and Wellington.

The second westerly spell lasted from the 19th to the 22nd. Northerly or north-westerly gales were particularly severe. At Wellington the twenty-four hours ending at 9 a.m. on the 21st was one of the windiest ever experienced. In Canterbury, also, the high winds caused some damage. Very heavy rain fell on the ranges of the South Island during this period, and there were considerable snowfalls on the high levels. Thunderstorms were recorded at many places. A combination of rain and snow in a thunderstorm and a north-westerly gale was responsible for the loss of five lives on the Tasman Glacier on the 19th. At Auckland, on the 21st, a torrential downpour caused flooding in some of the city streets. The steamship "Awarua" was struck by a thunderbolt while at Half-moon Bay, Stewart Island, on the 20th.

During the remainder of the month the storm systems were mainly of cyclonic form. On the 8th a shallow cyclone developed in the Bay of Plenty, and deepened rather rapidly through the night. At the same time a rather intense anticyclone crossed the southern portion of the South Island. The result was that strong southerly or south-easterly winds suddenly set in, and rose to gale force in places, especially in Cook Strait. Temperatures fell sharply, bringing on an unusually cold spell for the season of the year. Rain was almost general, with many heavy falls between the 8th and the 11th, especially on the 8th and 9th, eastern districts receiving the highest totals. On the night of the 8th snow fell on the mountain-tops of the South Island, and hail was recorded at places.

Another cyclone approached New Zealand on the 14th and passed through Cook Strait on the 15th. Except in the far north and the south-west, there was again general and heavy rain. Falls were particularly heavy in Canterbury, where there was much flooding. In the Ashburton County the floods were the heaviest known.

Almost general rains with many heavy falls, especially in the South Island, were again experienced on the 27th and 28th, when a cyclone moved across Canterbury.

Thunderstorms were rather numerous during the month.

RAINFALL FOR JANUARY, 1930, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average January Rainfall.
	North Island.				
		Inches.		Inches.	Inches.
1	Kaitaia	2·46	10	0·81	3·36
2	Russell	2·19	11	0·47	4·11
3	Whangarei	2·76	12	0·83	4·08
4	Auckland	8·40	14	1·74	2·66
5	Hamilton	5·51	15	1·70	3·94
5A	Rotorua	9·91	15	2·59	4·30
6	Kawhia	7·13	16	2·46	3·52
7	New Plymouth	5·13	20	1·24	4·42
8	Riversdale, Inglewood ..	11·23	18	3·63	7·43
9	Whangamomona	8·52	19	2·37	6·05
10	Eltham	5·69	17	1·37	3·92
11	Tairua	2·87	9	0·61	4·35
12	Tauranga	5·52	12	1·59	4·34
13	Maraehako Station, Opotiki	3·58	14	1·72	4·29
14	Gisborne	3·11	8	1·02	2·97
15	Taupo	4·29	12	1·58	3·71
16	Napier	4·94	11	1·66	3·18
17	Maraekakaho Stn., Hastings	4·41	11	1·75	2·29
18	Taihape	4·04	21	0·58	3·28
19	Masterton	6·32	18	1·89	2·69
20	Patea	5·16	18	0·88	3·79
21	Wanganui	3·90	10	1·20	2·87
22	Foxton	2·91	13	0·56	2·30
23	Wellington (Karori Reservoir)	6·41	19	1·44	3·31
	South Island.				
24	Westport	4·61	19	1·23	8·20
25	Greymouth	6·84	17	1·59	9·03
26	Hokitika	7·00	17	1·18	9·87
27	Ross	9·81	17	2·00	12·04
28	Arthur's Pass	24.40	13	10·14	9·36
29	Okuru	8·17	15	1·38	12·86
30	Collingwood	10·75	17	3·14	6·95
31	Nelson	5·76	14	2·59	2·82
32	Spring Creek	5·35	12	1·95	2·22
33	Tophouse	7·86	21	1·18	5·14
34	Hanmer Springs	7·07	19	1·22	3·74
35	Highfield, Waiau	6·20	13	1·54	2·95
36	Gore Bay	5·28	14	1·66	2·71
37	Christchurch	5·08	16	1·52	2·21
38	Timaru	6·38	19	2·14	2·30
39	Lambrook Station, Fairlie ..	5·78	15	1·34	2·38
40	Benmore Station, Clearburn	2·95	14	0·59	2·77
41	Oamaru	2·25	16	0·53	2·11
42	Queenstown	3·69	15	1·35	2·72
43	Clyde	..	..	..	1·72
44	Dunedin	4·25	19	0·71	3·36
45	Wendon	2·29	13	0·60	3·22
46	Gore	..	..	..	3·09
47	Invercargill	3·91	20	0·60	4·01
48	Puysegur Point	8·41	22	1·70	7·22
49	Half-moon Bay	6·05	16	1·21	4·68

—*Edward Kidson, Director of Meteorological Services, Wellington, 6th February, 1930.*

TESTING OF PUREBRED DAIRY COWS.

C.O.R. LIST FOR JANUARY, 1930.

* Cow milked three times daily during whole lactation period. † Milked three times daily during part of period.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
	JERSEYS.	Yrs. dys.	lb.		lb.	lb.
Junior Two-year-old.						
Erinview Doree ..	J. Murray, Woodville ..	2 68	247·3	365	9,813·8	630·08
Ngahiwi Lady Romance	W. J. Freeth, Waitara ..	2 18	242·3	365	9,438·1	625·25
Waipiko Jubilant ..	C. G. C. Dermer, Cheltenham	1 285	240·5	365	9,590·6	570·25
Ngahiwi Sunshine ..	W. J. Freeth, Waitara ..	1 359	240·5	365	7,994·7	505·42
Ngahiwi Fancy ..	W. J. Freeth, Waitara ..	2 8	241·3	365	7,623·6	490·49
Waipiko Cullana ..	C. G. C. Dermer, Cheltenham	2 18	242·3	365	9,798·7	477·79
Te Kinga Sunbeam*..	R. S. Tuck, Waharoa ..	2 54	245·9	365	6,350·4	466·13
Waipiko Charm ..	C. G. C. Dermer, Cheltenham	2 46	245·1	365	9,106·9	452·64
Ngahiwi Lady Bronze	W. J. Freeth, Waitara ..	1 346	240·5	365	9,250·2	446·06
Lea Rig Fringe ..	A. C. Christie and Co., Hikurangi	2 54	245·9	365	9,066·3	440·53
Waipiko Consequence	C. G. C. Dermer, Cheltenham	1 325	240·5	365	8,092·7	439·21
Ngahiwi Lady Eleanor	W. J. Freeth, Waitara ..	1 333	240·5	365	7,555·7	437·57
Jersey Farm Freda ..	H. R. Benbow, Ormondville	2 33	243·8	365	8,531·1	433·56
Jersey Farm Gem ..	H. R. Benbow, Ormondville	2 27	243·2	365	6,878·6	377·32
Ngahiwi Sweet Ease	W. J. Freeth, Waitara ..	2 76	248·1	232	6,142·8	352·10
Wattle Grove Ivy ..	W. Robinson, Patumahoe ..	2 49	245·4	362	5,818·8	338·58
Flat Park Perfection	R. Wattam, Cambridge ..	2 17	242·2	352	7,294·3	338·12
Conandale Easter Wonder	S. Dale, Fairlie	1 353	240·5	293	4,578·9	264·90
Wattle's Hearty ..	D. J. Willis, Greatford ..	1 333	240·5	263	4,815·7	254·00
Senior Two-year-old.						
St. Marino Lassie ..	G. M. Harris, Hikutaia ..	2 320	272·5	365	9,982·6	611·44
Huia Buttercup ..	H. G. Lever, Tauranga ..	2 128	253·3	365	8,186·8	414·37
Burnside Darling ..	S. J. Hollard, Rowan ..	2 291	269·6	355	5,334·2	320·32
Three-year-old.						
Alfalfa Zenith ..	T. and A. Smith, Otorohanga	3 347	311·7	365	10,302·5	574·65
Moss Rose of O.K. ..	A. E. Watkin, Takanini ..	3 364	313·4	336	9,603·9	527·63
Waipiko Curious ..	C. G. C. Dermer, Cheltenham	3 355	312·5	360	8,484·7	518·30
Dainty Lady of O.K.	A. E. Watkin, Takanini ..	3 253	302·3	365	10,204·7	513·27
Velebit Fox's Freda*	G. E. Yelchich, Waiuku ..	3 174	294·4	365	7,909·9	500·59
Tyntesfield Eunice ..	R. K. Garland, Okauia ..	3 98	286·8	365	7,755·7	497·06
Joyeuse of O.K. ..	A. E. Watkin, Takanini ..	3 358	312·8	365	9,274·5	496·16
Orange Dale Rower's Beauty	Estate of W. J. Hall and Son, Matatoki	3 313	308·3	281	8,112·6	458·64
Four-year-old.						
Ivondale Darling ..	R. S. Tuck, Waharoa ..	4 21	315·6	365	12,044·5	676·77
Waipiko Butter Girl..	C. G. C. Dermer, Cheltenham	4 342	347·7	365	10,744·6	616·96
Mature.						
Daisy's Buttercup* ..	Estate of G. H. Selby, Waiuku	10 30	350·0	365	14,811·5	820·94
Middlewood Gladful	A. G. Somervell, Takapau..	6 76	350·0	365	13,000·8	728·31
Reid Park Daylight	W. Craig, Waiuku ..	6 53	350·0	365	10,991·1	669·23
Grafton Fuchsia ..	Mrs. V. A. McIlveen, Taupaki	7 290	350·0	347	11,026·9	625·97
Waipiko Buttermaid	C. G. C. Dermer, Cheltenham	10 61	350·0	365	11,370·1	593·07
Orange Dale Alice ..	Estate of W. J. Hall and Son, Matatoki	6 36	350·0	360	9,552·7	545·22
Brooklyn Neat Maiden	H. J. Lancaster, Glen Oroua	6 9	350·0	332	9,419·4	549·26

LIST OF RECORDS—*continued*.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
	JERSEYS—*continued*.					
Mature—continued.		Yrs. dys.	lb.		lb.	lb.
Oaklands Lady Brampton	F. W. Cornwall, Bell Block	6 296	350·0	329	9,820·4	543·29
Marshlands Tango Fern	A. E. Watkin, Takanini ..	6 8	350·0	365	10,244·0	519·10
Burnside's Lady Twylish	S. J. Hollard, Rowan ..	8 197	350·0	311	7,428·5	365·64
	FRIESIANS.					
Junior Two-year-old.						
Rosevale Jessica Sylvia*	H. North and Sons, Omimi	2 171	257·6	365	17,871·5	641·32
Rosevale Catrina Posch Echo*	H. North and Sons. Omimi	2 123	252·8	365	18,470·7	624·71
Greenhill Sylvia Rose 4th*	C. J. Neville, Clandeboye ..	2 104	250·9	365	14,843·4	603·35
Lenslea Cloverette Nancy*	L. H. Leslie, Bennetts ..	1 341	240·5	365	14,040·3	536·18
Forestvale Sylvia Mimosa*	Messrs. Tait Bros., Greenhills	2 29	243·4	365	15,127·7	519·53
Greenhill Alcartra Sylvia 3rd*	C. J. Neville, Clandeboye ..	2 16	242·1	365	13,919·0	462·46
Oakview Colantha Sylvia	Oakview Stud Farm, Auckland	2 5	241·0	365	13,265·9	446·08
Sealands Alcartra Corona	H. G. A. Cameron, Weraroa	1 357	240·5	352	9,538·6	388·03
Dominion Olga Segis	Central Development Farm, Weraroa	1 342	240·5	237	9,639·4	364·00
Dominion Woodcrest Daisy Queen	Central Development Farm, Weraroa	1 355	240·5	249	9,582·6	347·59
Dominion Domino Carnation	Central Development Farm, Weraroa	2 21	242·6	237	8,384·0	259·64
Senior Two-year-old.						
Rosevale Lady Abbekerk Posch	W. Bryant, Otokia ..	2 228	263·3	318	11,149·6	360·87
Rosevale Lassie Posch II	W. Bryant, Otokia ..	2 331	273·6	345	10,529·3	333·77
Junior Three-year-old.						
Rosevale Queen Daphne Triumph*	H. North and Sons, Omimi	3 172	294·2	365	17,896·4	648·21
Senior Three-year-old.						
Totara Pontiac Lady*	Piri Land Co., Auckland ..	3 364	313·4	331	15,397·1	699·98
Rosevale Sylvia Plus Keyes*	H. North and Sons, Omimi	3 282	303·2	365	19,485·1	660·57
Sealands Mercedes Fobes	H. G. Cameron, Weraroa ..	3 359	312·9	365	14,703·8	446·18
Anawhata Dorothy Minto 12th	Estate of P. F. Boucher, Onehunga	3 361	313·1	331	11,695·4	435·75
Junior Four-year-old.						
Rosevale Countess Johanna Posch*	H. North and Sons, Omimi	4 176	331·1	365	24,517·6	743·58
Senior Four-year-old.						
Rosevale May Gipsy Sylvia*	H. North and Sons, Omimi	4 347	348·2	365	19,019·0	631·24
Pauline Domino of Braystone†	A. R. Weal, Pukeatua ..	4 360	349·5	344	11,734·2	415·04

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
	FRIESIANS—*continued.*					
Mature.		Yrs. dys.	lb.		lb.	lb.
Rosevale May Echo Catrina*	H. North and Sons, Omimi	5 143	350·0	365	20,786·8	700·64
Rosevale Model Keyes*	H. North and Sons, Omimi	8 228	350·0	365	16,164·2	655·39
Monavale Felicity Paxton†	R. Marr, East Tamaki ..	10 34	350·0	323	17,795·1	655·24
Rosevale Amelia Sylvia*	H. North and Sons, Omimi	6 352	350·0	365	18,895·4	577·31
Rosevale Jewel Sylvia*	H. North and Sons, Omimi	5 281	350·0	365	15,720·3	558·38
Minnie Jessie of Oakview	Oakview Stud Farm, Auckland	8 31	350·0	365	13,535·1	550·44
Rosevale Audrey Sylvia*	H. North and Sons, Omimi	7 23	350·0	346	17,015·5	524·80
Bracken Queen Daffodil†	A. R. Weal, Pukeatua ..	5 332	350·0	365	15,982·6	497·64
	MILKING SHORTHORNS.					
Junior Two-year-old.						
Hairuia Esther 2nd†	A. L. Souter and Son, Waerenga	2 36	244·1	365	8,834·5	383·83
Senior Four-year-old.						
Victoria Frolic 1st ..	J. Bateman, Invercargill ..	4 315	345·0	323	9,005·7	348·44
Mature.						
Matangi Hazel ..	J. Bateman, Invercargill ..	6 364	350·0	342	9,768·0	406·75
	AYRSHIRES.					
Four-year-old.						
Sadie 1 of Greenbank†	W. Moore, Masterton ..	4 12	314·7	365	10,451·6	526·83
Mature.						
Maesgwyn Poppy* ..	C. Morgan Williams, Kaiapoi	8 309	350·0	316	14,936·5	506·14
	Second-class Certificates.					
	Jerseys.					
Junior Two-year-old.						
Te Kinga Superior Beauty*	R. S. Tuck, Waharoa ..	2 31	243·6	365	7,145·0	456·95
Pinewoods Dairymaid	G. H. Bell, Oakura ..	2 32	243·7	365	7,853·3	428·55
Burrwood Rosette ..	J. B. Tonar and Son, Northcote	1 344	240·5	365	6,234·9	338·72
Rockview Blossom ..	Estate of W. H. Fitness, Rehia	1 295	240·5	348	5,327·3	285·09
Senior Two-year-old.						
Blarichburn Bright Eyes	F. S. McRae, Palmerston North	2 314	271·9	365	8,997·6	527·13
Mature.						
Bridge View Floss ..	A. E. Watkin, Takanini ..	5 302	350·0	365	9,333·8	569·01
Ona	F. J. Ryburn, Paterangi ..	5 74	350·0	365	9,922·6	555·23
	Friesians.					
Senior Four-year-old.						
Rosevale De Kol Plus Sylvia*	H. North and Sons, Omimi	4 263	339·8	313	18,647·9	575·66

STATISTICS OF PASTURE TOP-DRESSING ON FARMS, SEASON 1928–29.

Land District.	Actual Area top-dressed.	Superphosphate.		Basic Slag.		Other Artificial Fertilizers.		Stable and Farm Manure.	Lime.	
		Area.	Quantity applied.	Area.	Quantity applied.	Area.	Quantity applied.	Area.	Area.	Quantity applied.
	Acres.	Acres.	Cwt.	Acres.	Cwt.	Acres.	Cwt.	Acres.	Acres.	Cwt.
North Auckland	342,840	164,994	456,342	146,667	441,257	61,732	170,546	505	17,134	80,419
Auckland	886,996	698,241	1,800,953	165,817	395,007	131,653	301,776	659	56,224	158,028
Gisborne	38,805	34,550	75,206	2,922	4,270	2,750	5,471	7	1,456	7,030
Hawke's Bay	101,716	92,141	204,589	4,264	11,143	4,475	9,471	130	2,843	15,146
Taranaki	317,598	122,907	289,126	194,025	485,208	20,714	47,631	103	12,486	42,096
Wellington	291,331	195,776	445,512	66,589	166,297	29,986	74,788	498	16,837	101,425
Nelson	22,178	17,724	36,619	3,171	7,864	1,114	2,230	108	2,745	27,850
Marlborough	18,252	16,149	26,220	586	1,295	1,685	2,783	79	633	4,401
Westland	6,621	4,685	10,198	280	568	1,133	2,856	116	1,348	8,825
Canterbury	100,707	90,897	135,482	1,082	1,960	3,212	6,280	242	13,092	76,094
Otago	82,684	58,948	120,584	5,920	13,011	7,077	16,790	326	21,027	231,653
Southland	175,464	106,871	244,256	28,612	61,173	42,181	83,191	193	77,548	604,439
Totals, 1928–29 ..	2,385,182	1,603,883	3,845,087	619,935	1,589,053	307,712	723,813	2,966	223,373	1,357,406
Totals, 1927–28 ..	..	1,369,050	3,405,808	276,967	812,695	518,199	533,531	3,150	118,124	1,031,278

NOTE.—In cases where farmers top-dressed the same areas with two or more of the fertilizers quoted, either separately or as a mixture, duplication of such areas under the appropriate fertilizer headings may have resulted. Consequently the actual total area top-dressed is somewhat less than the sum of the areas appearing under the individual fertilizer headings.

—Census and Statistics Office.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

BLUESTONE SOLUTION FOR DRENCHING SHEEP.

G. H. MARSHALL, Kakatahi :—

Regarding the bluestone solution for drenching lambs, is this remedy effective against all parasites infesting stomach and bowels of sheep? It is a common practice hereabouts to use 4 oz. bluestone to the gallon and to give a 1 oz. dose. I notice the Department recommended a solution of less strength and a larger dose. Would one method be likely to be more effective than the other? Is it essential to use a copper drenching-tube? Would a galvanized tube allowed to stand awhile in a copper solution be equally effective, or would it still continue to coat with copper and thus weaken the solution used for the drench?

The Live-stock Division :—

The bluestone solution is not effective against all parasites infesting the alimentary canal of sheep. It is, however, effective against the stomach-worm, which is considered to be the most harmful parasite. The strength recommended by the Department is 1½ oz. bluestone to the gallon of water, the dose varying up to 3 oz. for adult sheep. If the solution used by you has proved to be safe it may be continued, but the weaker solution has been proved to be non-injurious. The actual dose of bluestone administered per animal is about the same in each case. A copper drenching-tube is advisable, as the solution corrodes other metals. It is a weak solution, and if the tube is rinsed with water immediately after use the corrosive effect will be practically negligible.

PRECAUTIONS IN USE OF SODIUM CHLORATE AS A WEED-KILLER.

C. H. JENKINS, Onehunga :—

In the *Journal* for August last the Horticulturist refers to the use of sodium chlorate for weed-killing, stating that it is inflammable and directions given with it should be strictly adhered to. I should be glad to have further information on this point, as the seedsmen's shops do not appear to stock this material.

The Horticulture Division :—

Regarding necessary precautions in the use of sodium chlorate, experiments are now being carried out by the Fields Division of the Department, with a view to ascertaining just what are the risks and advantages of this material as a weed-killer under local conditions. Meanwhile the following extract from an overseas publication may be of some use to you: Sodium chlorate in contact with finely divided organic matter forms a combustible mixture. Clothing, fine straw, or chaff that has been moistened with a solution of this material and permitted to dry may be ignited by friction or a spark and become a fire menace. For these reasons sodium chlorate should be handled carefully. The spray solution should not be prepared inside barns or sheds, and if clothing becomes saturated it should be thoroughly rinsed before being allowed to dry. It is advisable to wear rubber boots while spraying, and to keep wagons and spray equipment well painted.

CONTROL OF WIREWORM PEST.

H. A. FINCH, Hokitika :—

I have a piece if land which is literally alive with wireworms and grass-grubs. I was not aware of the presence of wireworms until I commenced digging a crop of potatoes off this land, the crop being almost a total loss. The land referred to is of rather a light sandy nature. What would be the best and quickest way

of ridding the land of the trouble? Would a heavy crop of mustard be of any use? I would like to grow another crop of potatoes on the same piece of ground next year.

The Fields Division :—

The growing of a crop of white mustard and turning in under as it comes into flower is quite a good method to adopt where wireworms are troublesome. Wireworms are usually found on newly-broken-up land, but at times they are very plentiful under other circumstances, and where that is the case a crop of mustard ploughed or dug in seems to completely overcome the pest. We have not noticed any case of wireworm damage to potatoes following a crop of mustard. On one occasion when wireworms were plentiful a crop of mustard was sown, but there was insufficient seed to sow all the block, with the result that one part was left fallow. The whole block was planted in spring with potatoes. Where the mustard had been dug in the tubers were free from damage, while on the other part the crop was unfit for table purposes. You should procure the mustard from your seedsman, and sow at the rate of 15 lb. per acre.

GOATS AND FOOT-ROT.

"NEW CHUM," Levin :—

Please inform me whether goats suffer from and spread foot-rot?

The Live-stock Division :—

Goats in their wild state do not suffer from foot-rot, so far as our knowledge goes, but when confined to low, wet pastures are liable to become affected, although never to the same extent as sheep.

LYMPHANGITIS IN MARE.

"SUBSCRIBER," Studholme Junction :—

I have a dry mare, aged thirteen, periodically troubled with swelling of the hind legs, making them resemble an elephant's. Also, along under the stomach, from front to back legs, there are swellings like broad, flat veins. None of it is puffy, but feels quite hard to the touch. The mare is running in good grass and has had very little dry feed. I would be glad of any information regarding the cause and treatment of this trouble.

The Live-stock Division :—

Swelling in the hind legs such as you describe is known as lymphangitis or weed, and is usually met in horses of the heavier type, especially those of a lymphatic or sluggish nature. The swelling is the result of an accumulation of lymph in the lymphatic vessels. The cause of this complaint is generally an overabundance of good food and lack of exercise, although occasionally it is met in horses low in condition. In working horses it occurs after a short period of idleness, and is sometimes known colloquially as "Monday morning disease." The disease has a marked tendency to recur, and after repeated attacks the limb becomes permanently enlarged, and an incurable condition termed elephantiasis or "elephant-leg" develops. For treatment give a physic ball composed of Barbadoes aloes, 5 to 7 drams (according to size of mare) and ginger, 2 drams. It will be necessary to prepare the mare by giving two or three bran mashes before and after giving the ball. Hot fomentations should have been applied to the legs in the first place, but they may not be of much benefit now. However, you could try them. Preventive measures should be adopted by giving laxative feeds and exercising the mare.

Wool Clips.—The amount of wool shorn in the season 1928–29 was 203,118,870 lb. from sheep and 7,580,793 lb. from lambs. In the season 1927–28 the respective figures were 187,883,202 lb. and 7,004,322 lb. The average fleece per sheep weighed 8·03 lb. in 1928–29, as compared with 7·84 lb. in the previous season.

ESTIMATED YIELDS OF WHEAT, OATS, AND BARLEY.

THE following estimated average yields per acre of wheat, oats, and barley for the season 1929–30 have been compiled by the Census and Statistics Office from reports furnished by Inspectors of the Department of Agriculture throughout the Dominion, and issued under date 11th February :—

District.	Wheat. Bushels per Acre.	Oats. Bushels per Acre.	Barley. Bushels per Acre.
North Island	34·03	39·47	38·39
Nelson	24·00	30·00	35·00
Marlborough	30·72	35·00	34·91
Canterbury	30·40	38·61	31·54
Otago	30·89	38·26	36·26
Southland	36·61	45·50	41·17
Average (estimated) for the Dominion, season 1929–30	30·56	39·71	33·89
Average (actual), for the Dominion, season 1928–29	34·60	41·93	40·06

In accordance with the above estimates, the total yield of wheat for the Dominion should be approximately 7,100,000 bushels, as against an actual yield of 8,832,864 bushels for the season 1928–29.

The percentage of oats threshed for the five seasons ending with 1928–29 was 28·87 of the total area under that crop. Assuming that a similar proportion is threshed this year, the total yield of grain should be approximately 3,150,000 bushels, as against an actual yield of 3,065,113 bushels for the season 1928–29.

The percentage of barley threshed for the five seasons ending with 1928–29 was 98·23 of the total area under that crop. Assuming that a similar proportion is threshed this year, the total yield of grain should be approximately 680,000 bushels, as against an actual yield of 781,102 bushels for the season 1928–29.

FORTHCOMING AGRICULTURAL SHOWS.

THE following show-dates have been notified by agricultural and pastoral associations :—

Marton A. and P. Association : Marton, 26th February.
Auckland A. and P. Association : Auckland, 27th February to 1st March.
Taranaki Agricultural Society : New Plymouth, 5th and 6th March.
Waikato Central Agricultural Association : Cambridge, 5th and 6th March.
Morrinsville A. and P. Society : Morrinsville, 12th March.
Hawke's Bay A. and P. Society : Autumn Show, Tomoana, 19th March.
Methven A. and P. Association : Methven, 29th March.
Oxford A. and P. Association : Oxford, 3rd April.
Flaxbourne A. and P. Association : Ward, 10th April.

Spray Injury to Apple-trees.—"During November last several instances of injury to fruit by spraying came under notice" (reports Mr. J. H. Thorp, Orchard Instructor, Nelson). "The injury consisted of the blackening of the skin of the apples, and occurred chiefly on trees sprayed during a period of changeable weather after spraying with lime-sulphur plus arsenate of lead, and lime-sulphur plus precipitated sulphur plus arsenate of lead. The varieties affected were Cox's Orange and Sturmer. In my opinion, the injury resulted from the applications being made when moist, muggy conditions were prevailing, causing excessive fuming of the sulphur compounds."